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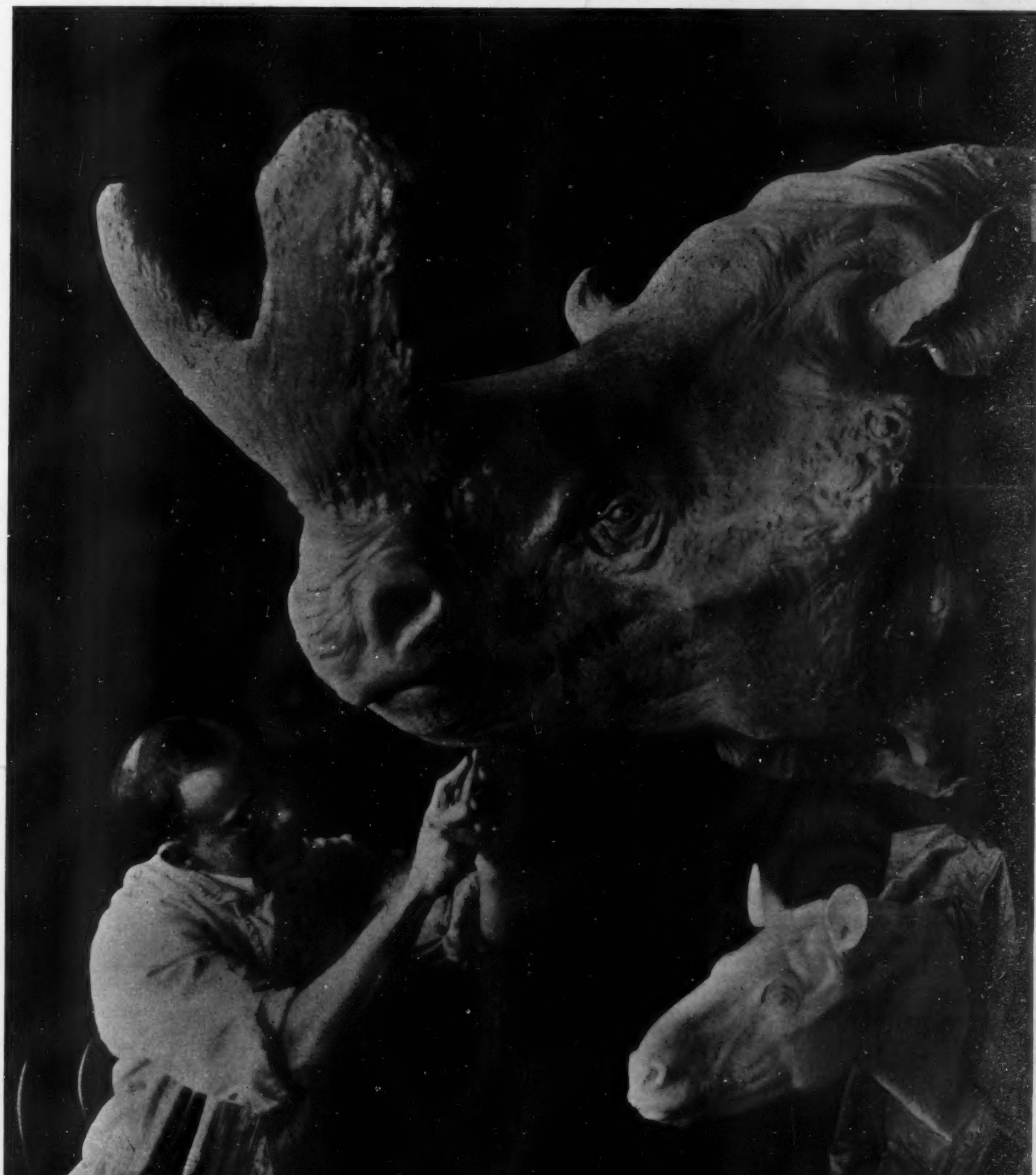

The small hornless head represents the first ancestral type of the group, and the massive head with two-foot horns the final member at the pinnacle of their evolution.

THE TITANOTHERE, ANCESTOR OF THE RHINOCEROS—[See page 315.]

SCIENTIFIC AMERICAN
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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Senseless Forest Bill

CONSIDER these forests facts: The National Forests contain nearly one fifth of the standing timber of the United States. They protect the head waters of every important Western river, and support for a part of each year one half the sheep and nearly one tenth of the cattle feeding on the western range. Dependent upon them is a vast irrigated tract, redeemed from aridity and semi-aridity by an investment of over $300,000,000. In these national forests there are 500,000,000,000 feet of merchantable timber worth, if valued at only $1 per thousand feet, $500,000,000—more than half the national debt. At present the government spends about $5,000,000 gross or $3,000,000 net to protect this timber. Spread over an area greater than all the United States north of the Potomac and east of the Ohio River, is a field force of about 2,000 men, whose duty it is to keep an eye out for fires. The force seems large, yet there is only one ranger to every 150 square miles.

An intelligent man, told that there is now pending before the House a bill which affects the Forest Service, would naturally suppose that a wise body of legislators intended to remedy this wretched condition by providing adequate protection for so valuable a national resource. Not so. Incredible as it may seem, the 1912 House bill actually reduces an appropriation, which has averaged about $500,000 annually for the past five years, $275,000. It is difficult to believe that the Senate will permit so senseless a measure to become a law, still more difficult to believe that the President will sign it, if the Senate should concur with the House.

To protect our National Forests more money should be appropriated, *not less*. Surely one man cannot adequately protect one hundred and fifty square miles of timber land. Surely on three cents an acre valuable timber cannot be adequately protected. How can the building of roads, trails, bridges and telephone lines so urgently required to get men quickly to the fires be carried on efficiently if Congress ties the hands of the Forest Service? Just as good farming means building up the productive capacity of the land, not merely preventing it from running down, so good forestry means not only protection, but also improvement. Congress apparently has nothing else in mind than the degradation of national timber lands.

"Doping" Athletes With Oxygen

THE lay press reports that Sir Edwin Ray Lankester has inquired if the Swedish authorities, who will have charge of the coming Olympian games, will permit a Marathon competitor to carry an oxygen tank or bag and take from it an occasional whiff during that cruel and grueling twenty-six odd miles that must be run by those who would be in at the finish. The competitors, he observes, will presumably be allowed to consume refreshments while racing. "It would be extremely interesting to see whether such breathing is of material assistance to the runner; and as oxygen gas is not a drug, but as natural an article of consumption as water, there seems to be no reason why the runner should be disqualified for refreshing himself with it, as he may with soup or water."

Stimulating drugs are, of course, rightly barred from any athletic contest worthy the name. Oxygen is in these circumstances certainly a drug, inasmuch as it "dopes" the recipient, quite like many another drug. Pure oxygen is a powerful and most valuable stimulant for the sick who require it—patients with coma or pneumonia *in extremis*. But, as with all stimulants, excessive and occasionless use of it is dangerous. It first excites and then depresses; frequent oxygen intoxication will prematurely exhaust the individual's vitality, and will surely tend to shorten his days. Such indulgence will make the cardiac beats most pathologically rapid and powerful; the blood will flow in excessive volume and strength; and the collapse will be in reciprocal proportion. The ears sing in an "oxygen jag," as if one should hang head downward over a cliff; speech is hesitating; "ideas swarm, but it is hard to seize them."

Sir Edwin's proposal is amazingly unscientific in a scientist of so great reputation; and it is most unsportsmanlike, especially in an Englishman, the Britisher being nothing if not a lover of fair play in sport. What folly to declare nascent oxygen as natural an article of consumption as water! Pure oxygen is far from being such a thing; it is natural only to be breathed when it is diluted with several times its volume of nitrogen.

Pure oxygen has before been used in athletics; but all that kind of thing is altogether cheap and unprofitable; it has a yellow streak. Yes, records have been broken by this means. They should not stand; they do not in the minds of the sporting aristocracy. And the reason why is that they are not tests of brawn and endurance under the inexorable conditions in which human life must ordinarily be lived. An oxygen drunk might make an untrained, undeveloped, soft-muscled, ordinarily short-winded specimen successful for the brief span of a given contest; but for all that he would be the poorer, and not the really triumphant man. All competitions should be held under natural conditions, such as must be chanced and coped with in nature.

The only safe and sane way to breathe oxygen is in combination with nitrogen as it exists in the circumambient air, in the form to which, during the ages, human and all other life has become adapted. Normal living is ever "the right adjustment of internal relations to external relations."

After all, why should Marathons be run anyway except for the glorious and sufficient purpose of announcing in the Athenian market-place the victory at Marathon over the Persians? How utterly purposeless is to-day this terribly taxing race, which must for many a participant result in disease and in shortened existence.

Controlling Water Waste.

EFFICIENCY in maintenance is no less a characteristic of good engineering than originality and boldness of construction, yet often such work fails to receive recognition, though it may involve ingenious methods and the application of the most advanced scientific ideas. Thus, the detection and prevention of leakage and waste in the water distribution system of a large city may be cited as engineering work of trivial importance in comparison with the construction of great aqueducts. Nevertheless the matter is hardly less serious.

When large cities are spending millions of dollars on new water supplies it would seem that all municipal authorities should give heed to the extraordinary waste that may be found in their distribution systems. It has been authoritatively estimated that one half of the total supply of the Metropolitan District (Boston) is wasted, while the preventable waste and unaccounted-for loss of New York city has been estimated at from 40 to 70 per cent. In Chicago in 1908, T. C. Phillips, Engineer of Water Surveys, stated that "the total loss of water in the districts surveyed in the city of Chicago amounts to from 70 to 80 per cent of the total supply."

That there is extraordinary waste in most American cities is all too well known. Part of the water waste, caused by citizens and consumers, can be controlled by inspection and the use of meters, but a more serious trouble is underground leakage.

So prodigal have American cities been with water that notwithstanding a per capita consumption far in excess of European municipalities, they have failed to realize the vast waste until actual measurements leading to the uncovering of mains or the examination of fittings have brought home conclusively the condition of the system. In Washington, D. C., where conditions were such as to lead to an agitation for an increased water supply, it was found that the deficiency was due primarily, not to increased consumption, but to leaks in the distribution system from which in 1910 over six million gallons a day, or almost one tenth of the mean daily rate, escaped. Removing the causes of this leakage by inspection and repairs has made it possible to postpone for some twenty years the provision of additional water works, the estimated cost of which was $5,000,000.

In this connection recent work of water waste prevention as carried on in the city of New York, described on another page of this issue of the SCIENTIFIC AMERICAN, is not without interest. By the pitometer and house-to-house inspection methods together it has been found possible to account for the greater part of the waste, and once the source of trouble is known the remedy is simple and depends merely upon adequate appropriations and proper administration. Furthermore, like much municipal engineering work productive of valuable results, this prevention of water waste has not proved expensive. An organization has been effected that is producing great savings of direct advantage to the taxpayers. The tendency to allow the municipal plant to deteriorate is unfortunately too common in the United States. The advantages of scientific maintenance by competent engineers are strikingly illustrated in this branch of the work of New York's water department.

The Circular Track of Lost Persons

IT is a well-known fact that persons lost in a desert or other stretch of country which is utterly devoid of landmarks whereby they would be enabled systematically to pursue some definite path, tend to wander around in a circle, and often find themselves, after a certain lapse of time, back at the point from which they started. Possibly connected with this observation is the fact that in many religious rites of primitive peoples it is prescribed that a certain evolution, such as a dance around a shrine, be performed in a clockwise direction. Explanations have from time to time been proposed for this curious phenomenon, but in the opinion of a writer in *Prometheus* none of these hits the truth. Thus, for instance, it has been suggested that one leg is always a little longer than the other, and that this tends to cause a man's track to deviate from a straight line. But the writer observes, with justice, that if this were the true cause, then in our day, when every civilized person goes on his travels shod by the shoemaker's art, any slight difference in the length of his legs would be sure to be compensated in a large number of cases by an opposite disparity in the thickness of the soles of his shoes.

The author ascribes the deviation of a traveler's path from a straight line to the general asymmetric build of the body, and it is interesting to follow here his remarks as to the origin of this unsymmetrical arrangement. He quotes D. G. Brinton, who maintains that the upright posture of man is the immediate cause of his one-sided development, the anthropoid apes being ambidextrous. The adoption of the erect stature led to a redistribution of the forces and stresses in the animal economy in such a manner as to compensate for the additional tax laid upon the heart. As a matter of fact, Brinton tells us, the large arteries leading from the aorta conduct blood by a shorter path to the left half of the brain than to the right, and this has been the cause of a predominating development of the left cerebral hemisphere, which in turn determines the uneven development of the functions of the right and left half of the body.

The writer points out that a man's walk is not by any means a progression in a straight line, but that the body is alternately carried to the right and left with each step. We are unconscious of this, largely because the body compensates for the motion, which becomes much more evident if by special effort the trunk is kept rigid and stiff while walking. In point of fact it is found that the right foot points outward in nearly all individuals more than the left, and thus in walking the influence of the right leg tends to outweigh that of the left, not because it is longer or stronger, but because it is moved at a slightly greater angle from the general line of progress. Again, if we attempt to cross the street in the dark, we feel very much more at ease and confident if we cross obliquely to the right than if we move in a direction inclined to the left.

Finally, the writer suggests that perhaps the faculty which many animals have of finding their way, under circumstances where human instinct would fail, may be ascribed to the fact that, walking as they do on four legs, they are free from this defect of an asymmetric mode of progress. Here perhaps the author has gone a little too far, and is entering the field of speculation on slender basis.

Electricity

Electrical Laboratory for Harvard.—The Harvard Graduate School of Applied Science has received a gift of $50,000 for a high tension electrical laboratory. This laboratory is to be equipped with transformers to convert alternating current to a very high pressure for the purpose of experiment. It will also provide for high tension direct current experiments. The donor of the laboratory has not been announced.

Motorman's Mirror for Watching the Rear Platform.—An interurban electric railway of the Middle West has made ingenious use of the mirror for a purpose somewhat similar to that of the chauffeur's mirror on the automobile, and in connection with a recent ruling of the State Railroad Commission requiring the conductors of electric cars to walk ahead of their cars on steam railroad grade crossings. The mirror is hung on the front platform at an angle to give the motorman a clear view of the rear platform during the absence of the conductor from his post.

Electric Heating of Block Signal Mechanism.—The extremely unfavorable weather conditions of the past winter have been a severe test for automatic railroad signals. This difficulty has been neatly overcome in a new type of automatic block signal on an interurban electric railway west of Cleveland, Ohio. The lighting is provided by a single 25-watt tungsten lamp supplied from the trolley through a resistance. The mechanism is driven by a high speed 1/10-horse-power motor designed to operate safely through a wide variation of line voltage. The lamp and its resistance contained in the mechanism case furnish enough heat to prevent accumulation of ice on the lenses and mechanism.

Electricity vs. Brawn on the Farm.—A recent demonstration of the economies effected by putting electricity to work "doing the chores" of the farm showed that electric power can supplant human muscle in this field quite as well as the electric light can supplant the old, oil-dripping barn lantern. The generator, driven by an oil engine, supplied current to an outfit of motors for an automatic pump for the farm water supply, a centrifugal pump for irrigation and available for fire purposes also, a dairy installation (free from the dust thrown by belts and shafting) consisting of a refrigerating machine, a milk cooler, a cream separator, an automatic churn and butter worker, a bottle washer, and an ice-cream freezer, an electric truck, a large threshing machine, corn shellers and feed choppers, laundry machinery, milking machines, silo filler, flexible-shaft sheep shearer and horse and cattle groomer, ventilating fans and household equipment, including cooking devices.

Irrigation, Cultural Forcing and Transportation of Farm Products.—Electricity in agriculture has been highly developed in certain sections of Europe, and the old methods involving human and animal labor in the growing and marketing of crops promise to be revolutionized everywhere. Given enough electrical energy at a favorable price, generated at the farmer's own isolated plant or purchased from a central station company, there seems no limit to the usefulness of motor power on the farm, and other special applications are constantly being developed. For the irrigation of arid and semi-arid regions, electric pumping service is ideal. Thus in the raising of alfalfa in our own country, water may be raised to any desired height during the night, when the day load has fallen off. The artificial forcement of vegetation as a means of increasing the yield is a fascinating subject, the main processes being by the production of ozone and nitrate compounds and forcing them into the capillary systems of the plants by a copper network stretched over the field and continuously charged by a suitable electrical machine. Gaseous ozone and nitrous compounds are formed in the atmosphere, and are taken up by the moisture on the surface of the ground, forming an intensely active fertilizer which the electrostatic stress forces in to the growing plants. Another method is by electric lighting of the field, bringing the growth to maturity by "artificial sunlight" in less than the ordinary time. Experiments conducted near Breslau, Germany, in a field of 1,200 square feet, showed that the growth of strawberries, carrots, potatoes, barley and oats was increased (by the first-mentioned method) by various amounts from 10 to 50 per cent. Transportation is at present the most advanced of all electrical applications to farm work. The electric power has been found as useful in agriculture as it has already proven in urban haulage. An important feature in farm work is the time-saving as compared to horses. For example, a nursery near Rochester, N. Y., employs a 3.5-ton electric truck for delivering its products—trees and shrubs—to the railroad station four miles away, returning with fertilizer and other supplies. During the harvest season the same truck is utilized in harvesting the hay and wheat, carrying its 617 bundles of wheat easily, as compared with the ordinary two-horse load of only 260 bundles.

Science

Death of Prof. R. S. Tarr.—Prof. Ralph S. Tarr, of the Department of Physical Geography at Cornell University, died at Ithaca on March 21st. He was perhaps one of the best known geographers in the United States and an authority on glaciers and earthquakes.

Noteworthy Meteorological Lectures.—Prof. Willis L. Moore, Chief of the United States Weather Bureau, will deliver two lectures at the Royal Institution, in London, on June 1st and 8th, his subjects being "Meteorology To-day and To-morrow," and "The Weather and the Utilities of Forecasts."

Savage Landor's Latest Exploit.—A. H. Savage Landor, known to fame for his journeys across Tibet and central Africa, has been devoting his energies lately to South America. *Petermann's Mitteilungen* announces his arrival at Pará last December, after a journey through the heart of Brazil from south to north. The details of this journey have not yet been made known.

Retarding Asphyxia.—Asphyxia in confined air is retarded by hypodermic injections of oxygen, according to the researches of Béraud and Garrelon, and the human organism can make use of oxygen which is furnished in this way. The injected gas is seen to swell out the skin, but during a certain time carbonic acid gas appears and the oxygen diminishes at the same time.

Potato Disease.—A malady is beginning to attack the potato plant in Europe which is caused by an insect, *Phthorimea solanella*, and Prof. Bouvier has been studying the disease. It appears that it was unknown in France up to this time, but was noticed in America and New Zealand some years ago. The potatoes when piled in a cellar, for instance, are attacked by larvæ, which bore holes in them and spoil the potato entirely so that it cannot be used even for feeding stock. It has only appeared in the south of France at present, but did much damage in some places. It is easy to destroy the larvæ by sprinkling the cellars several times with bisulphide of carbon.

A Vegetable Sponge.—A substitute for the ordinary sponge of animal orange is offered by the fruit of an Egyptian plant, the *Luffa ægyptiaca*. The fruit of this plant contains an elastic fibrous network, which on being desiccated furnishes the "sponge." The fruit is plucked when of a fine uniform yellow color and hung up in the air to dry after the blossom end has been cut off. When the humidity has dried out the skin has become soft and supple and can then be drawn off like the peel of a banana. The residue is then soaked, stirred, and squeezed in hot water, after which it is again dried. This desiccation is a delicate operation requiring care, since if too rapidly done the fiber is fragile, while if too slow it is apt to become moldy. The seeds are then removed and the product is ready for use.—*Bibliothèque Universelle.*

A Forest Service Bulletin on Oak Woods.—The United States Forest Service has recently issued a publication on "The Identification of Important North American Oak Woods," which embodies the results of detailed studies based on the anatomy of the secondary wood. The bulletin should prove of value in bringing to wood users reliable and much needed information concerning a group of woods of such great economic importance. It contains an analytical key for the identification of all the important native oak woods, and explains how to prepare a piece of wood for examination with the pocket lens and with the high power microscope. The subject has been for many years the object of study of painstaking investigators; but the popular demand for a less technical discussion of the subject has induced the proper authorities in the Forest Service to prepare a bulletin on the anatomy of this group of woods so that it will be easily comprehended, and at the same time helpful to manufacturers of lumber, architects, builders, and other wood users. It was felt that the layman is likely to derive the greatest assistance from exact reproductions of transverse sections of the woods and for this reason the bulletin was illustrated by pen drawings. The illustrations were made by outlining with a pen photographs of enlarged transverse sections of the wood, and they show the exact appearance of each section as seen under a microscope magnifying the structure twenty times its natural size. The text of the bulletin is illustrated with forty-two such drawings, and in addition to these two full pages of small drawings of the wood elements are given. All of these are new and original, having been prepared with a thorough realization of the need of accurate illustrations of these woods in the transverse sections as well as of the wood elements. There are still a limited number of copies to be had gratis from the Department of Agriculture. After this supply is completely exhausted copies can be secured only from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price covering approximately the cost of printing.

Aeronautics

Causes of Aeroplane Accidents.—It is very difficult to determine the cause of most aeroplane accidents, but during the investigation which followed the fatal accident to Lieut. Sevelle recently in France an important discovery is said to have been made by eye-witnesses. This was that the wing of his Blériot broke downward instead of upward, indicating that there was an extreme downward pressure as he started to volplane. Experiments lately made in France are said to have confirmed this, and it is now believed to be necessary to guy the wings as substantially above as below.

Transport and Assembling of Army Aeroplanes in France.—The French army is commencing to use horse-drawn vans for aeroplanes, so that these can be transported over the road to any desired point and then be quickly assembled. Not long since an experiment was made which shows how rapidly a monoplane can be made ready for flight. At the Mailly camp the van was brought near one of the batteries, and a Blériot monoplane was taken out and put together. In spite of a violent wind prevailing at the time, one of the officers made a successful flight. But even more remarkable than this flight in the wind is the very short time that was needed to assemble the aeroplane and get it ready. This was accomplished in exactly seventeen minutes from the moment the van stopped for unloading to the beginning of the flight.

A Mammoth Monoplane.—The first flying tests of a "Pigeon" monoplane of remarkable dimensions, constructed by E. Rumpler, were recently made at the Johannistal aerodrome. The most interesting feature of this machine are its two Argus motors of 100 horse-power each, which actuate two propellers of different size rotating in the same direction and which are mounted on a shaft at the front part of the aeroplane. Each motor can be started separately—the rear one by means of a crank. The chassis is of very substantial design to sustain the heavy weight of the aeroplane. The body contains two seats. The wings and body of the aeroplane are like those of the standard Rumpler "Pigeon," except for their greater dimensions. In connection with the first flying tests, this aeroplane reached a considerable speed, and its further successes are being watch with keen interest. It claims the distinction of being the most powerful real flying machine in the world.

Tabuteau's Two-hour Record and Pau-Paris Flight.—The last of February Tabuteau, with a 50-horse-power Morane-Saulnier monoplane, beat by 29.144 kilometers his second best previous two-hour record. The new record is 234.431 kilometers (145.66 miles). In 2:07:4 1/5 Tabuteau covered 250 kilometers (155.34 miles), breaking the previous record of 2:22:57 3/5. Not content with aerodrome records, M. Tabuteau, on March 11th, flew from Pau to Villacoublay—720 kilometers or 447.38 miles—in 4 hours 45 minutes at an average speed of 94.18 miles per hour. He covered the 261 miles between Pau and Poitiers (where he stopped for lunch) in 2 hours and 20 minutes, or at an average speed of 111.85 miles per hour. Thus he succeeded on a cross-country flight in averaging for 2 1/3 hours 7½ miles an hour more than Vedrines averaged for 1 hour on an aerodrome and this with a motor of but about one-third the power. The remainder of the journey was covered in a violent wind and heavy showers. Deducting a stop of 10 minutes at Etampes to change a spark plug, the time in flight for the remaining 186 miles was 2 hours and 25 minutes (77 miles per hour). The average speed for the entire distance was 94.18 miles per hour.

Tests of Our New Military Biplane.—The official trials of the army's new 75-horse-power Curtiss military biplane at Augusta, Ga., have been concluded, except as to the climbing test. The specifications under which this machine was built are regarded as the most severe that have ever been drawn up by the United States Army, and by some, more severe than those governing the trials of aeroplanes in the foreign military service. In the matter of speed the big biplane, which has 37- by 5-foot planes (the upper being extensible to 43), made an excess of 2½ miles an hour above the requirements, while the motor sustained an endurance test of 2 hours and 10 minutes in the air. The biplane was prepared for transportation from flying shape, in 33 minutes, and was re-assembled for flying in 55. It landed on and started from soft, mushy, plowed ground, according to requirements. The engine throttled well and flew the machine at reduced speed also. In the climbing test, the machine ascended 1,000 feet in 7 minutes, carrying 450 pounds and fuel for four hours' flight, making the total weight over 600 pounds. As the conditions at Augusta were not favorable to carrying out the climbing test, a further trial to meet this particular specification will be made when the Army Aviation School is moved from Augusta, Ga., to College Park, Md., this month. This new machine is equipped with the Curtiss dual shift control, enabling either occupant to operate it at will.

Saving $2,000,000 Water Waste a Year

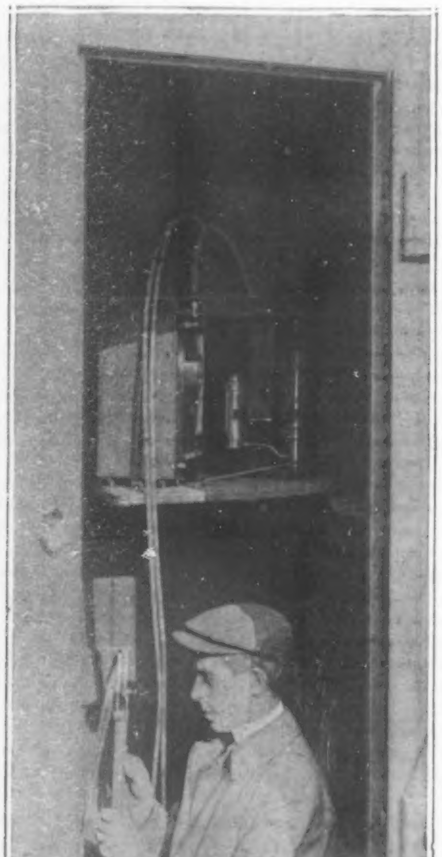
The Remarkable Result Accomplished by a Simple Invention

By Herbert T. Wade

As much of New York's distribution system is old and its maintenance in many cases deficient, there are vast losses due to underground leakage. Fractured mains, imperfect connections and joints, abandoned service pipes, dead ends and the like all contribute, while defective plumbing fixtures and waste on the part of householders bring the grand total to an impressive figure.

Realizing this, Commissioner Henry S. Thompson and the Chief Engineer, I. M. de Varona, established a special division of water measurement and water waste under F. B. Nelson, C. E., which in connection with the Bureau of the Water Register has effected some striking economies through a system of measurement and inspection.

The extent of this work is shown by the fact that up to the end of last October the total saving resulting from the activity of the division of water measurement and water waste amounted to 15,728,000 gallons daily. To this must be added the saving effected by plumbing inspections made in 1911, which in Manhattan amounted to 21,275,000 gallons, or 12.2 per cent in the districts measured, and in the Bronx 2,336,000 gallons, or 18 per cent. In other words, the water waste of the city of New York thus stopped would represent at the meter rate of 10 cents per 100 cubic feet nearly



The Pitot tube was connected by rubber tubing with a long U-tube containing an insoluble liquid of greater specific gravity than water.

$5,000 daily, or $1,825,000 annually, an amount that represents about one per cent of the annual budget of the city.

As now organized the study and detection of water waste has become a comparatively simple matter, and useful instruments and methods have been evolved that enable this to be done with a high degree of precision, so that any trouble can be localized and repairs made immediately.

The first essential is the determination of the amount of water flowing through the mains by the measurement of the velocity of flow. This is done with the "pitometer," an instrument developed from the Pitot tube, devised about 1732 by the French engineer of that name, into an automatic self-registering instrument. The Pitot tube consists of an L-shaped tube. The long arm stands vertically in the water, while the other, which is very short, terminates in an orifice. In the instruments used for measuring flow in mains under pressure, one Pitot tube is held with its orifice toward the approaching current, while the orifice of the other tube opens toward the receding flow. In the tube open to the current the water will flow in and cause the level to rise above that of the water outside, while in the tube whose arm points in the direction of the current there will be a corresponding fall.

This device has been studied and improved by hydraulic engineers and other scientists, and the instrument as developed into the pitometer by Edward S. Cole, C.E., is illustrated herewith. The tubes with the two orifices are mounted on a rod which can be inserted in the main to be investigated through an ordinary one-inch standard corporation cock. The corporation cock is put in with the usual water main tapping mechanism, which not only drills a hole but inserts the cock similar to that used for service pipe connection without disturbing the flow of water or producing waste. Through such an outlet by means of an appropriate coupling and gland the rod containing the Pitot tubes is inserted so that the orifices may be placed at any height desired in the main.

The Pitot tubes are connected by rubber tubing with a long glass manometer or U-tube containing an insoluble liquid of greater specific gravity than water, usually 1.25, and colored red. When the rod is inserted in the main the water will rise in both tubes, and after the air is permitted to escape will come in contact with the colored liquid in each arm of the U-tube. If there is no flow of water in the main the colored liquid, of course, will stand at the same height in both arms, but with any flow a difference of pressure will be indicated by a difference of level, magnified as it is by the heavier liquid at the bottom of the U-tube.

A photographic record of the rate of flow or velocity is secured by having the light from a lamp fall on the U-tube and pass through a narrow slit to a sheet of sensitized paper carried on a drum revolved by clockwork. As the denser liquid is colored red the light shining through it affects the velox paper less than that passing through the clear water, and a continuous record is obtained of the movement of the colored liquid in the U-tube.

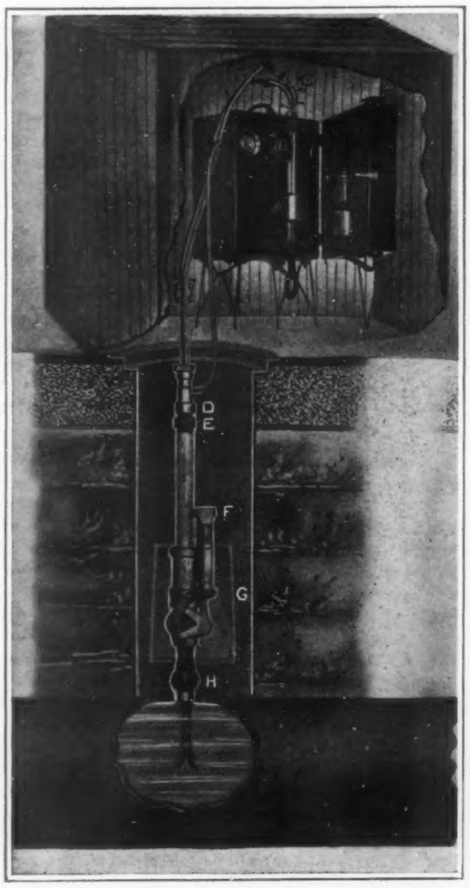
There are also a pressure gage and a metallic thermometer, whose indicators moving up and down the slit afford a continuous record of static pressure and temperature, the latter in case correction of the indications are necessary. In the recent types of pitometer a double prism enables readings to be made from both legs of the tube over a certain range, thus obviating errors due to expansion of the liquid and consequent change of zero location. The clockwork mechanism usually is arranged to run for twenty-four hours, and the instrument can be mounted temporarily for observations at any desired point. In most cases a small temporary house covering a manhole is used to house the instrument. There is also a pitometer without the photographic record for less extended measurements of the same essential nature.

The pitometer readings and the formula enable us to determine the velocity at any point in the main, but as this is not the same throughout, the velocity for a series of concentric rings must be determined and the average velocity computed for the entire flow. From such a traverse or investigation of a main at a certain point, a coefficient or ratio between mean and center velocities may be obtained. This is independent of the velocity but depends upon the incrustation and general state of the interior, and such local conditions as nearby curves. With the co-efficient thus determined, from the photographic record with the aid of tables the number of gallons passing through the main can be speedily and accurately determined.

With this method, correct to within two per cent, it is possible to investigate the conditions under which a distributing system is operating. As is well known, a city is gridironed by a network of mains to insure the greatest circulation of water and the minimum danger of interruption by failure at any single point, gate valves being located at convenient intersections. To study a particular district the valves are closed so that the supply comes from one or more mains, in each of which the flow is measured by a pitometer, while in the same way the water passing out of the district is measured, the difference being the consumption which, of course, is affected by local conditions. If a district is largely one of residences there should be little legitimate use of water between the hours of 11 P. M. and 5 A. M., so that if during this interval there is no marked decrease in the night consumption of water over that by day there is reason to suspect underground leakage or defective fixtures.

An official inspection house by house will reveal and perhaps remedy leaky fixtures, but the underground waste must be investigated by narrowing the area under test with the pitometer until the trouble is located or the general condition of the district established. The inspecting engineers can trace readily any departure from normal conditions and often these are most serious. Thus in 1910 and 1911 in New York and Brooklyn a pitometer examination was made of districts along the river front in order to ascertain what leakage was taking place directly into the river. Up to November 1st, 1911, a saving of 6,628,000 gallons a day along the water front and of 5,700,000 in mains crossing rivers had been effected. District by district the mains were examined, and at the Battery and on Whitehall Street, between South and Water Streets, leaks were indicated from which 880,000 gallons of water were wasting. This would mean a loss of 321,200,000 gallons a year, which at meter rates would represent $42,719. As a matter of fact the amount of water was more nearly a million gallons a day, for the measurements were made at low pressure.

The trouble here was found to be due to a broken 3-inch service line from which 360,000 gallons daily were



The pitometer, an instrument by means of which the city of New York saves millions of gallons of water that would otherwise be wasted.

escaping, and an open end upon which the gate valve was partially open and broken. After repairs had been made the water pressure in the vicinity was increased from 19 to 27 pounds.

International Agricultural Meteorology

Efforts have recently been made by the International Institute of Agriculture to induce the International Meteorological Committee to hold a special meeting in Rome this spring to consider plans for improving the organization of work in agricultural meteorology throughout the world. In view of the fact that the regular triennial meeting of the committee will be held next year, the proposed special meeting will not be held; but the directors of meteorological services have been requested to submit to the committee reports on the present status of agricultural meteorology in their several countries. These reports will constitute a document of unique interest, and will serve as a basis of discussion at the meeting of the committee in 1913.

Little-known Rainbows

A Group of Neglected Optical Phenomena

By C. Fitzhugh Talman

LITTLE-KNOWN rainbows may be divided into two classes: (1) Those that, though common, are inconspicuous and generally escape the attention of the casual observer. The supernumerary bows belong to this class. (2) Those that are rare, because they occur only under more or less exceptional circumstances. This class includes bows of unusual coloration—especially the "white" rainbow—reflected bows of all kinds, and bows of a higher order than the secondary (viz., the tertiary, quaternary, quinary, etc.).

The ordinary primary and secondary rainbows are familiar to everybody, and their phenomena were so fully explained over two centuries ago, by Descartes and Newton, that for a long time the scientific world believed there was nothing further to be learned about them. These phenomena were assumed to be invariable; a rainbow was simply a rainbow, and the meteorologist who noted the occurrence of one in his log-book thought it unnecessary to add a detailed description. To the late J. M. Pernter, whose writings have done so much to rescue all branches of atmospheric optics from the neglect into which this branch of science had fallen, is especially due the credit for having brought to general attention the many variations to which the phenomena of ordinary rainbows are susceptible. These variations will be more fully considered below.

Supernumerary Bows.

Supernumerary bows—sometimes called *spurious bows*[1]—are the bands of prismatic colors often occurring just inside the lower, or primary rainbow, and less frequently outside the upper, or secondary, bow. Tait describes them as having the appearance of ripples. They repeat the colors of the spectrum—sometimes several times over—green and red being usually predominant; the other colors are often indistinguishable. As stated above, they are apt to be overlooked in a cursory observation; but as a rule they are easily seen by anyone who looks for them, especially those attending the primary bow, and they are sometimes quite conspicuous. Some of them are shown at *DD* in Fig. 3.

The Newtonian theory of the rainbow took no account of the supernumerary bows. They were first explained by Young, in 1803, and more fully by Airy, in 1836-38. They are interference phenomena, due to the fact that, in addition to the rays of light producing the colors of the ordinary bow, there are other mutually parallel rays emerging from a raindrop after traversing unlike paths within the drop. For the complete explanation the reader is referred to Preston's "Theory of Light," third edition, page 536 ffg. One result of Airy's investigations was the discovery that the supernumerary bows vary in appearance with variations in the size of the raindrops.

[1] In German, "secundäre Bogen"—"secondary bows"—a name that, in spite of Pernter's recommendation, cannot be adopted for this phenomenon in English, where it has long been appropriated to another use. The bow that we call, in English, the "secondary," is called in German "Nebenregenbogen," the primary bow being called "Hauptregenbogen." Anyone who has occasion to consult the German literature of the rainbow will do well to bear in mind these confusion-breeding discrepancies in the terminology.

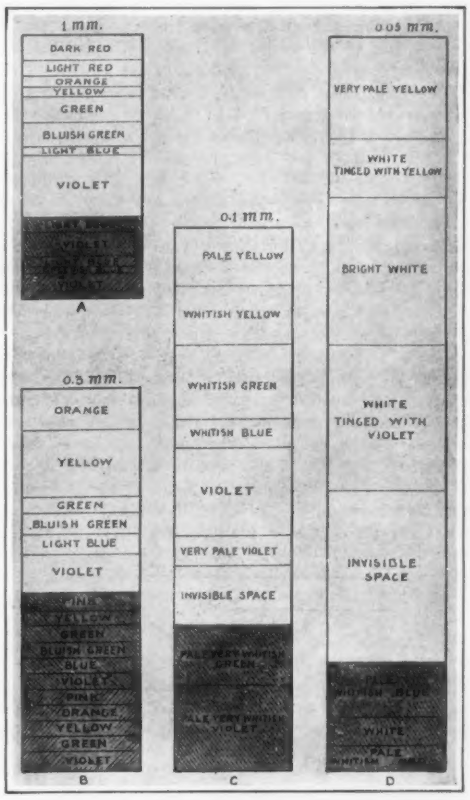


Fig. 1.—Relation of rainbow colors to the size of the raindrops (Pernter).

Fig. 2.—Intersecting rainbows. Seen by Halley, 1698.

The Colors of the Rainbow.

Formerly it was supposed that the primary rainbow was of a certain uniform breadth, and that the seven prismatic colors had a definite and invariable distribution therein. Turn to Brewster's "Optics," which was a standard work in the middle of the last century, and you will find the following statement: "The primary or inner rainbow consists of seven differently colored bows, viz., *violet*, which is the innermost, *indigo*, *blue*, *green*, *yellow*, *orange*, and *red*, which is the outermost. These colors have the same proportional breadth as the spaces in the prismatic spectrum." This is a good example of a class of ideas that gain acceptance by dint of reiteration in the textbooks, though unable to stand the test of even a small amount of careful observation.

As a matter of fact, all seven colors are rarely distinguishable in the rainbow, and the space occupied by each, when present, varies greatly from one bow to another.

Not until long after Airy's time was it generally understood that his explanation of the supernumerary bows has an important application to the ordinary bows. The latter, like the supernumeraries, vary greatly with the size of the raindrops. Small drops produce broad bows, and *vice versa*. Moreover, the smaller the drops the greater the superposition of the prismatic colors. Hence it is that the small drops constituting a fog, as distinguished from the larger drops that fall as rain, give us a bow in which the colors overlap to such an extent that they almost neutralize one another, and a so-called "white" rainbow is the result. This bow is not perfectly white; the lower border is more or less distinctly tinged with violet, and the upper is generally yellowish. As it is produced by fog, and not rain, it is often called a *fog-bow*.

White rainbows may, however, also be produced by rain, in the following manner: Since the luminous source of a rainbow is not a point, but a disk of finite magnitude (viz., the sun or moon) the light reaches the drop of rain from all points in this disk, and therefore at various angles. Hence there is a superposition of colors in all rainbows, and the colors never show the well-defined sequence of the pure spectrum. Now suppose in some way the luminous disk could be considerably increased in angular magnitude. There would result still more blending of the rainbow colors, and if the disk were large enough these would combine to produce white light. These conditions are fulfilled when the sun shines through thin clouds. Under these circumstances the sky for a degree or two around the sun becomes dazzlingly bright, and the luminous source is thus virtually

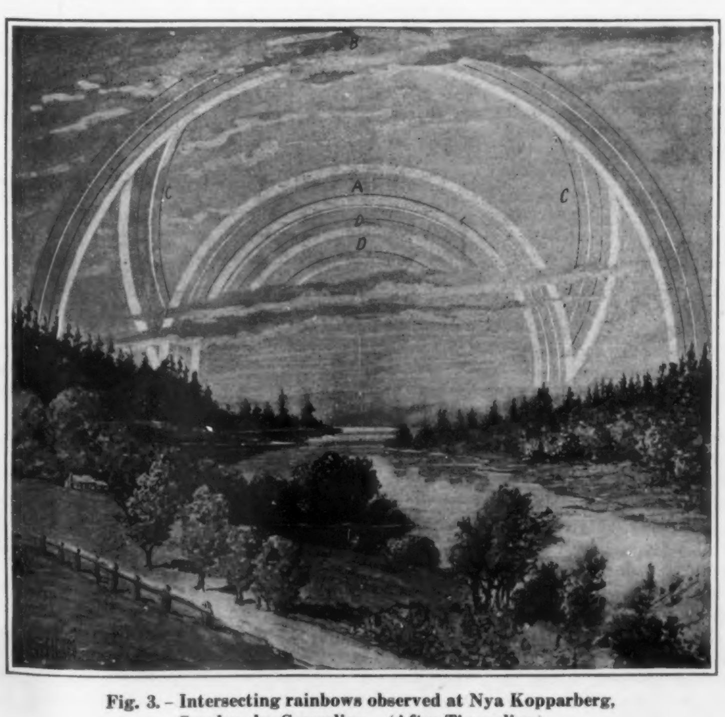


Fig. 3.—Intersecting rainbows observed at Nya Kopparberg, Sweden, by Gumælius. (After Tissandier.)

Fig. 4.—Intersecting rainbows observed at St. Andrews, Scotland, 1874. (After a sketch by T. Hodge.)

LITTLE-KNOWN RAINBOWS

spread over a large spherical angle. The effect is the same as if the disk of the sun, instead of spanning an angle of half a degree, had a diameter of two or three degrees. Parenthetically, it may be remarked that since the apparent diameter of the sun is greater at the earth's perihelion than at aphelion, the appearance of the rainbow varies slightly with the season; while on other planets than the earth, if rainbows occur at all, they must differ in appearance from those with which we are familiar.

The lunar rainbow is often described as "white," but here the apparent absence of color is simply the effect of feeble illumination. Bright lunar rainbows usually show the rainbow colors distinctly.

Lastly, a white circle, a little smaller than the rainbow, is sometimes seen from a mountain summit, or in the polar regions, on a bank of fog opposite the sun. This was long supposed to be a true rainbow, and was regarded as *the* white rainbow, *par excellence*; but Pernter has shown it to be a halo, produced by the reflection and refraction of light from crystals of ice. He calls it the *Halo of Bouguer*.

People who ought to know better sometimes report having seen a "white rainbow around the moon." This is, of course, a halo, and not a rainbow; and like the true lunar rainbow, seen in the part of the sky opposite the moon, it is not truly white, but appears so on account of its feeble lustre. A rainbow *around* the moon, or the sun, would be as much out of place as a palm tree at the North Pole.*

The way in which the colors of the rainbow vary with the size of the water drops producing it is illustrated in the accompanying diagram (Fig. 1) by Pernter, which shows sections of the bows resulting from drops having uniform diameters of 1 millimeter, 0.03 millimeter, 0.1 millimeter, and 0.05 millimeter, respectively. Diagrams *A* and *B* include, in each case, segments of two supernumerary bows (the shaded portions of the figures); in *C* and *D* only one supernumerary is shown in each. Although in nature the drops are never of quite uniform size, they are often so nearly so that these figures represent substantially bows that actually occur. At any rate they illustrate the fact that the appearance of the rainbow is by no means invariable. When the drops are about 1 millimeter in diameter (*A*) the colors are rich and intense; when they are smaller—say from 0.15 to 0.4 millimeter in diameter (*B*)—the colors are more numerous and distinct. Still smaller drops (*C*) produce a whitish bow, which is further distinguished by the fact that there is an unilluminated space between the primary and the supernumerary bows. The smallest drops (*D*) —those that occur in a fog, and are too small to fall rapidly as rain—give us a bow the middle of which is pure white; and here there is a still broader interval between the primary and the supernumerary bows.

Red rainbows have occasionally been observed. They occur when the sun is low and when its disk appears red, owing to selective scattering of its light.

Reflected Rainbows.

Reflected bows are among the striking phenomena of nature. They are of two kinds: (1) those produced by an image of the sun reflected in a body of water, or other horizontal surface, and (2) those that are themselves reflected from such a surface.

An example of the first kind is shown in Fig. 3. The sheet of water extends back of the observer, who is facing the rainbow. *A* and *B* are, respectively, the ordinary primary and secondary bows. *D*, *D* are supernumerary bows. *C*, *C*, which intersect the primary and secondary bows, are arcs of a circle whose center lies as far above the horizon as the center of the primary and secondary bows lies below it. This *extraordinary* or *intersecting* bow, as it is called, is formed by an image of the sun in the water behind the observer. The reader is, of course, familiar with the fact that in the case of the ordinary rainbow the higher the sun stands in the heavens the lower the bow, and *vice versa*. In the case of the extraordinary bow, the luminous source is, in effect, below the horizon; hence the center of the bow lies above the latter. If the angular altitude of the sun exceeds the radius of the bow the latter will be lifted entirely above the horizon, and if the curtain of rain extends high enough the bow will form a complete circle. Usually, however, only the lower part of such a bow is visible, and we have the phenomenon of the *inverted rainbow*.

Fig. 4 shows a fragment of an intersecting bow, together with an ordinary primary bow. It was observed by no less a person that P. G. Tait. (See *Nature*, vol. 10, 1874, p. 437.)

A celebrated case of a reflected bow was that seen by Halley, over the River Dee, in 1698. In this case the primary and secondary bows were both visible, and the reflected bow was between them. (See Fig. 2.) The reflected bow was observed to rise and the ordinary bows to sink (with the increasing altitude of the sun) until the upper part of the reflected bow mingled with the secondary for a certain distance, and this portion of the combined bows became white. This resulted from the fact that the order of the colors in the reflected bow was the reverse of that in the secondary; the red of the one coincided with the violet of the other, etc., producing white light.

Reflected rainbows of the second class are seen, not in the sky, but in the reflecting surface; i. e., usually a sheet of water. In this case the bow seen in the water is not the reflection of the *same* bow that is seen in the sky; in other words, the bow in the water does not exactly correspond to the reflection that would be cast by a wooden framework set up in the position of the series of drops producing the ordinary bow, and painted to imitate its colors. This will be clear from Fig. 5. The observer at *O* sees an ordinary rainbow produced by a series of raindrops, one of which is *R*. Another series of drops, of which R^1 is one, forms a bow that cannot be seen directly by the observer; the ray of light emerging from R^1 strikes the water surface at *W*, and is reflected upward to the observer *O*, to whom the corresponding point in the bow appears to lie in water at *B*. This bow in the water is, in fact, the reflection of the one that would be seen by an eye vertically below that of the observer, and as much below the surface as his eye is above it.

Nearly all works on optics that mention bows of this class (a majority ignore them altogether) convey a rather misleading impression as to the appearance of the bow resulting from the process above described. Unless the observer stands at a considerable elevation above the water the reflected rainbow due to distant raindrops does not differ sensibly from that which would be produced if the rainbow in the sky were an objective reality. An inverted bow is

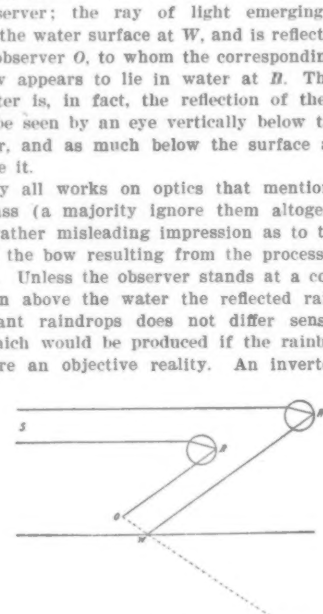


Fig. 5.—Explanation of reflected rainbow. (After Pernter.)

seen in the water, and its ends are continuous with those of the aerial bow. If, however, the observer stands far above the water, then the reflected bow will be a conspicuously smaller arc of a circle than is the ordinary bow, and the ends of the former will no longer "join on" to those of the latter.

Tertiary Bows, Etc.

The primary rainbow is due to one reflection and two refractions of light in the raindrops; the secondary bow to two reflections and two refractions. (See any encyclopædia or book on optics.) These deviations of the light determine the angular size and the position of each bow. Both are central at the antisolar point, and their radii are, respectively, 42 degrees and 50 degrees (measuring from the red border in both cases). Three reflections and two refractions would give us the *tertiary bow*, and geometrical optics shows that it would lie between the observer and the sun—i. e., it would encircle the latter, after the manner of a halo. Four reflections within the drop would give us the *quaternary bow*, and it, also, encircles the sun. The *quinary bow*, due to five reflections, would lie opposite the sun, its radius being a little greater than that of the secondary bow, which it would partly overlap. More reflections within the drop would give us bows of still higher order; in fact there is no limit to the number that may exist, theoretically.

Have bows of higher order than the secondary ever been seen? Some writers, including Pernter, say no (except in the laboratory). Others are non-committal; "rarely, if ever," is the usual verdict. The observation of the tertiary and the quaternary would certainly be most exceptional; the sun would need to be shining brightly *through* a curtain of rain, and the direct illumination of the sky about it would generally eclipse the relatively feeble light of the rainbow. The quinary, although in a much more favorable position, would be exceedingly faint on account of the many reflections undergone by the light rays, and could, at best, be seen only as a fringe above the secondary.

In view of the fact that no recent writer on optics appears able to refer to a specific instance of the occurrence of these necessarily rare phenomena, it is worth while to call attention to a paper published by Charles Hartwell in the *American Journal of Science*, second series, vol. 17, pp. 56-57, describing fragments of a tertiary bow observed by him at South Windsor, Connecticut, in 1851.

As to the quinary bow, Mascart, in his "Traité d'Optique," says that "it appears to have been sometimes observed," but he cites no specific instances.

Miscellaneous Phenomena.

The foregoing brief list of the vagaries of our familiar friend the rainbow is by no means exhaustive. The ancients were wise in regard to the sex of Iris—for she is infinitely various. It remained for a modern poet (Keats) to complain that we know all about her; but his famous plaint paid an undeserved compliment to the scion of his generation.

The rainbow is occasionally distorted by refraction. Pernter, in his "Meteorologische Optik" (p. 498), describes a case in which a streak of cloud between the observer and the bow caused such a distortion.

Sometimes from a mountain peak, or other elevation, when rain is falling at a lower level, a bow is observed apparently lying on the ground. Such a bow was seen on April 9th, 1908, from the observatory of Rocca di Papa, near Rome, stretching over the green vineyards of the Campagna; and a few days earlier a similar bow was observed from the Eiffel Tower, in Paris. These two observations were widely quoted, at the time, in the scientific journals, and not the least interesting circumstance in connection with them was the difficulty of naming them correctly in French. *Arc-en-ciel?* or *arc-en-terre?* Scientific terminology is frequently upset in this way by the whims of nature. We have seen above that we have similar problems in English. Rainbows may occur without rain; viz., on a bank of fog. Shall we still call them "rainbows"?

* The excessively rare tertiary and quaternary bows, described later in the article, as well as theoretical bows of still higher order, are ignored in making this statement.

The Abnormal Summer of 1911

ALTHOUGH, so far as the public at large is concerned, the remarkable heat, drought and continuous sunshine experienced in Europe, and to some extent in North America, during the summer of 1911, has ceased to be a topic of current interest, meteorologists are just now assembling the results of accurate observation of this subject, and it has already been discovered that during the period in question more or less unusual weather prevailed throughout the world.

While Europe and the United States were abnormally warm, the greater part of South America was experiencing an exceptionally cold winter. While the drought in our country and Europe was most severe, South America was treated to a drenching probably unprecedented in that part of the world.

From the meteorological log books of a number of vessels it appears that the trade winds over the North Atlantic were exceptionally strong during the summer of 1911. During the same period the meteorological station at Punta Arenas, at the southern extremity of South America, a location well within the "roaring forties," or zone of the "brave west winds," noted the highest average wind velocities for fifteen years, September being the stormiest month on record. These observations from two of the most definitely marked wind zones of the earth indicate that, as might be expected, the general circulation of the atmosphere was strongly affected by the unusual thermal conditions.

It remains to be seen just what disturbance in the great "centers of action" of the atmosphere were responsible for the weather anomalies of 1911, and whether these disturbances can be traced to any extraterrestrial cause.

Political and Economic Aspects of the Mawson Expedition

IN the many recent notes and articles published in the scientific journals regarding the antarctic expeditions now or lately in the field certain unique features of the Australian venture under Dr. Mawson appear to have been overlooked.

In the first place this party, before leaving home, received official authority to take possession of the coast of the antarctic continent facing Australia on behalf of the commonwealth of Australia. This action is explained by the fact that the antarctic shores are believed to be not without economic value. It is said that there is some prospect of discovering coal deposits near accessible harbors. A more definite project, however, appears to be that of establishing a profitable fishing industry in these regions; especially whaling, which has had, of late, a revival in polar and sub-polar waters.

The wireless stations which Dr. Mawson was to establish at Macquarie Island and on the shore of Antarctica itself might, if the expectations of the explorers are realized, be made permanent, and we should then have a southern parallel to Spitzbergen, which has been put into wireless communication with the world on account of its coal mines and fisheries.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Selden Case and Its Voluminous Record

To the Editor of the SCIENTIFIC AMERICAN:

In your editorial entitled "The Inventors' Guild" in your issue of March 9th, in writing of the patent procedure before the courts under the present practice, you say:

"The Selden patent with its score of volumes of printed testimony is a brilliant example of the absurd lengths to which we go in needlessly complicating infringement suits."

I regret to say that you have in this statement apparently been misled by many of the loose statements that have been published officially or unofficially in regard to the record in the Selden patent case, and it is for the purpose of correcting such statements and placing the matter in its true light before the patent public that I send you this communication.

In the first place, it is spoken of as "the Selden case," as though there was but one case brought and but one record; this is incorrect. There were five cases involved in the litigation, and in the consolidated hearing, which was then termed "the Selden case." The defendants in these five cases were first, Duerr & Co. and the Ford Motor Company; second, the O. J. Gude Company; third, John Wanamaker et al. These three cases were termed the "Ford cases" because the Ford machine was the asserted infringing machine. In the early inception of the case an order was obtained from the court compelling all the testimony taken in these three Ford cases to be considered as testimony in each of them, and therefore only one record was made for the three cases. This order was conditional upon allowing the complainants to set aside an order of hearing on pleadings and proofs only, and as a condition it could be imposed by the court. The fourth suit was against the Panhard Company so called, and the fifth suit against Neubauer et al.; the last two cases were based on foreign machines, the Panhard and the Mercedes. This made three distinct records, modified, however, as follows:

On complainants' *prima facie* proofs on each of these cases tending to show infringement, there were made at first five records. In behalf of the defendants in the Panhard and the other cases, acting by the same counsel, they endeavored to obtain stipulations that the testimony taken in defense in the Ford cases should be stipulated into those cases without taking it over again, but this was refused. The court also, as I am informed, refused to make an order to that effect, and I think it was right in that it did not have the jurisdiction to make such an order except as a condition. There was, therefore, three records made in the defense: the (1) Ford, (2) Panhard, and (3) Neubauer cases; in which the testimony both as to facts concering anticipatory matter and experts' evidence was substantially identical and might have been taken but once for the three cases as well as not if the counsel and court could have agreed upon it.

On the testimony for the rebuttal taken by the complainants, it was stipulated by the defendants at complainants' request to allow the testimony taken in the Ford cases referred to, to apply in all of the cases, and only one record thereof was made. During the taking of complainants' testimony they introduced a number of exhibits, some of which had not been seen by the defendants, introduced testimony as to their operations which had not been witnessed by any of the defendants or their counsel and concerning which, March 7th, 1907, in the Ford cases, the court made an order that such operations should be repeated in the presence of defendants' counsel and that they might take testimony with regard thereto. In the Panhard case a similar but later order was made to the same effect. The complainants took very nearly a year after this order of March 7th before they gave up trying to make the complainants' machines operate to their satisfaction, and during this time they repeatedly changed the construction of the principal exhibit, Selden's motor car, by changing its pistons, its cylinder heads, and operative mechanism and various other parts, and attempted to operate these changed constructions, claiming they were operating under the order of the court. This ceased February 24th, 1908. These attempts were watched by defendants' counsel and experts, and detailed testimony given with reference thereto, stating the exact facts instead of stating opinions derived from observations merely. Subsequently some further testimony was taken by the complainants under an order of the court allowing a rebuttal of this testimony taken by defendants.

Finally, a stipulation was entered into in all of the five cases permitting reference to testimony and exhibits found in any of the records in any of the cases on the hearing, thus virtually making the cases as presented to the court one case. This status of the cases and stipulation was stated in the briefs and on the argument.

As to the volumes, etc.:

In the Ford cases, complainant took one volume of testimony and one small thin volume of exhibits on its *prima facie;* in rebuttal, defendants took two volumes of testimony, and as all the exhibits were bound together in all of the cases, ultimately there were two volumes of exhibits and one small volume of court records that was thought best to print for convenience, or five altogether.

In the Panhard cases there were taken four volumes of testimony as printed; the exhibits were contained in the two volumes of exhibits in the Ford cases, or rather the exhibits were entered in all of the cases and contained as stated in two volumes, and one volume of court orders, etc. Of the records in the Ford and Panhard cases, the two volumes of defendants' evidence were practically duplicated for the reasons stated. The complainant had in all, including small volumes of exhibits and everything, I believe, seven volumes as printed in all of the cases, and you will see that this is very far from making twenty volumes of printed testimony, and that instead of their being but one case in which twenty volumes of printed testimony was taken, there were substantially three cases, and that nearly half of the testimony in the three cases was duplicated or triplicated and then counted up as so many printed volumes of printed testimony in one case.

The lower court did not discriminate between cases in its now somewhat famous note on this "Selden case," and although it is plain that the five cases had been condensed into the one hearing in the manner in which I have stated, but undoubtedly unwittingly left the inference to be that there was but one case substantially and that the duplicated records, etc., therein were unnecessary and the volume of testimony excessive.

The only criticism as to "volumes" of testimony, however, was with regard to the testimony taken showing the attempts made by the complainants to run the Selden engine or engines. Of course, all of that testimony might have been put into one page as an opinion by the experts who witnessed it, but under the discretion of counsel it was deemed best to state the exact facts exactly as they occurred, no matter how voluminous the testimony might be, and leave the court to draw its own opinion from the facts. In this proposition unquestionably the judgment of counsel and court might readily differ; and were it to be done over again by the same counsel, it would be done in precisely the same way regardless of the criticism by the court. One additional volume contained this evidence and applied to all the cases.

One word further if I am not trespassing too much. The great trouble on actions brought for infringement of patents is that where several actions are brought against different infringers, the identity of the patent and the identity of the issues on its validity and anticipations cannot be thrashed out on one taking of evidence for all of the cases so long as there is no identity between the defendants. The courts have no power to make orders consolidating cases of like type and requiring testimony to be stipulated from one to the other except as a condition of granting some relief to the complainants in the manner heretofore stated, in which the three Ford cases so called were consolidated. If the statute gave power to the courts to allow and order testimony in one case to be considered in another, the same as though taken therein, and thus compel litigants to accept that situation, saving to them any additional testimony they might see fit to take, in very many of these cases, not only time and records would be shortened, but expense would be saved. The Selden case so called with its five original cases is a good illustration of this point.

In all due fairness to those who were engaged in that famous case, I ask you to publish this communication and give it as prominent a place as the statement to which I have referred.

R. A. PARKER,

Counsel for all of the defendants in said actions.

Detroit, Mich.

[Perhaps the best reply to this letter is to be found in the comment of Judge Hough in handing down the decision in the case of the Electric Vehicle Company vs. C. A. Duerr & Co. (172 Federal Reporter, page 923) involving the validity of the Selden patent. Here is that comment, which shows that a far greater number of volumes of testimony were taken than our correspondent states:

"It is a duty not to let pass this opportunity of protesting against the methods of taking and printing testimony in equity current in this circuit (and probably others) excused, if not justified, by the rules of the Supreme Court, especially to be found in patent causes, and flagrantly exemplified in this litigation, as long as the bar prefers to adduce evidence by written deposition, rather than *viva voce* before an authoritative judicial officer, I fear that the antiquated rules will remain unchanged, and expensive prolixity remain the best-known characteristics of equity. But reforms sometimes begin with the contemplation of horrible examples, and it is therefore noted that the records in these cases, as printed, bound, and submitted, comprise thirty-six large octavo volumes, of which more than one-half contain only repeated matter, i.e., identical depositions, with changed captions, and exhibits offered in more than one case. In reading the testimony of one side in one set of cases, there were counted over one hundred printed pages recording squabbles (not unaccompanied with apparent personal rancor) concerning adjournments, and after arriving at this number it seemed unnecessary to count further. In many parts of the record, there are not five consecutive pages of testimony to be found without encountering objections stated at outrageous length, which may serve to annoy and disconcert the witness, but are not of enough vitality to merit discussion in two thousand pages of briefs. Naturally tempers give way under such ill-arranged procedure, and this record contains language, uncalled for and unjustifiable, from the retort discourteous to the lie direct. And all this lumbers up the court record room, while clients pay for it! Even when evidence in equity was taken by written answers to carefully drawn interrogatories, the practice was not marked by economy or celerity; but stenography and typewriting, the phonograph and linotype, have become common since our rules were framed, have made compression and brevity old-fashioned, increased expense, and often swamped bench and bar alike by the quantity, rather than the quality, of the material offered for consideration. Motions to expunge and limit cross-examination should have been made in these cases, though they are feeble remedies, exposing counsel to personal reproach, and rendering judges afraid of keeping out of evidence what they cannot (on motion, at all events) understand. But the radical difficulty, of which this case is a striking (though not singular) example, will remain as long as testimony is taken without any authoritative judical officer present, and responsible for the maintenance of discipline, and the reception and exclusion of testimony."

For the rest, Mr. Parker's letter sets forth by its own words the unnecessary complexity of our patent procedure.—EDITOR.]

The Rotary Mimeograph Decision

To the Editor of the SCIENTIFIC AMERICAN:

The decision of the Supreme Court in the case of Sydney Henry et al. vs. A. B. Dick Company again presents the question as to the rights and obligations of patentees. While the ruling of the court has caused much surprise, those familiar with the United States patent act fully realize that the case at issue is only one of many which may act as a burden to industrial progress in this country. This is so, for while our patent act has been so worded as to carefully guard the rights of inventors, it has failed wholly to make provisions for safeguarding the rights of the public in those cases where the owner of the patent hinders the progress of our industries and the growth of our country by efforts to obtain some advantage in addition to a reasonable profit for the use of the patented device.

When considering the wrong and the remedy, it is well to familiarize ourselves with patent legislations in other countries, and, at a glance, the contrast between our patent laws and those of other countries is very marked. In practically all the foreign countries there are provisions in the patent acts which in some way guard the public's rights. Abroad they have kept in mind the importance of the industries profiting by inventions, and they have made it impossible for the inventor to bury the patent for the full patent term, or to permit the use of the invention only under unnecessarily burdensome conditions. One of the provisions found in the patent acts of many countries requires the patentee to grant licenses permitting others to manufacture in return for a reasonable consideration when the manufacture is not being carried on by the patentee in such a manner that those desiring to use the invention may be able to do so on the payment of a reasonable price. Such a provision in the United States patent act would correct the evil. Of course, the question of a reasonable price may cause some difficulty in construing the statute; but in view of the fact that the law would be remedial, it would be awkward for the courts to construe the new legislation in such a way as not to protect the public, while at the same time the inventor's interests would receive protection.

EVERARD B. MARSHALL.

The Home-made Chemical Fire Extinguisher

To the Editor of the SCIENTIFIC AMERICAN:

We notice with interest an article in your issue of February 24th, 1912, relating to a chemical fire extinguisher. We note that the extinguisher therein recommended and roughly described by your correspondent is in essential features an example of our extinguisher. In this country a patent covering said extinguisher was applied for February 25th, 1911, which patent has since been finally allowed and will shortly be issued. It bears serial No. 610,883. A number of foreign patents have also been obtained.

New York, N. Y. THE ELECTRENE COMPANY.

The Trial Trip of the "Florida"

IN a rough sea and a brisk wind the "Florida" averaged 21.974 knots on five top-speed runs over the Rockland course on March 25th. That record gives her the blue ribbon of the American navy, and places her beside the British dreadnought "Vanguard" in point of speed. On one of her five runs the "Florida" made 22.54 knots, which is just a shade better than the "Vanguard's" 22.50, and appreciably better than the "Utah's" 21.637 knots, the best hitherto attained by an American ship.

As we have pointed out previously, the "Florida" is an exceptional vessel. In the first place, she was built by the Government itself at the Brooklyn Navy Yard, under conditions distinctly less favorable than those that obtain in private yards, thereby demonstrating that our naval constructors are capable of building the largest and most modern warships. In the second place, she may be regarded as the last word in warship design; for both the "Florida" and her sister ship the "Utah" are rated as the best protected warships afloat.

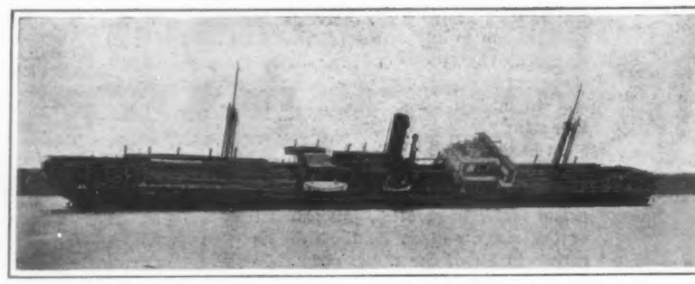
The "Florida" is a 21,825-ton battleship with a length of 521 feet 6 inches, a beam of 88 feet 2½ inches, and a mean draft of 28 feet 6 inches (with two-thirds full supplies, store and fuel and full supply ammunition). She is driven by Parsons turbines working on four shafts, which turbines are by contract required to develop 28,000 horsepower. This propelling machinery was to give her an average speed of 20.75 knots, which she exceeded as we have seen. The "Florida" will store, when completed, some 400 tons of oil fuel in addition to 2,500 tons of coal. It will be remembered that the "North Dakota" and "Delaware" are likewise provided with oil-tanks in addition to coal bunkers.

The "Florida" is armed like the "North Dakota," with ten 12-inch guns, but instead of fourteen 5-inch torpedo-repelling guns she carries sixteen. The 12-inch guns are mounted in five turrets on the center line of the ship. In point of armor protection, the "Florida" leaves nothing to be desired. Her belt armor varies from 12 inches to 8 inches in thickness; her turret armor is 12 inches, and her battery armor 6½ inches. Her smokestacks are protected by 9½ inches. Against torpedo attack the "Florida" is safeguarded by an elaborate subdivision of the hull and an unusually powerful pumping plant for removing such water as may enter.

Perils of the Deck-load

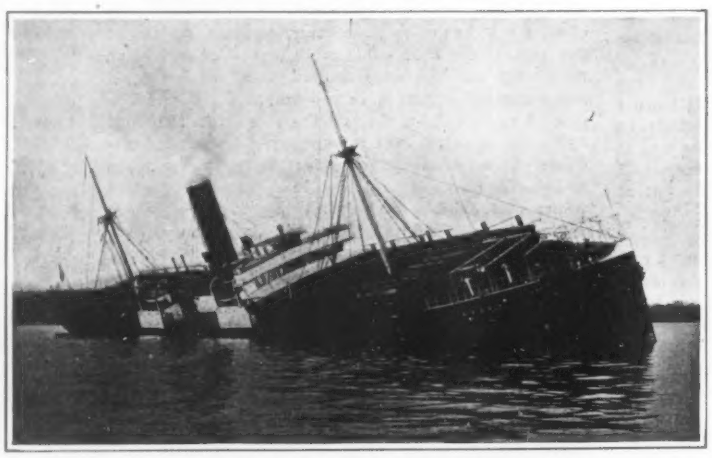
By James G. McCurdy

THE deck-load has always been an important factor in the lumber carrying trade out of Puget Sound ports. Vessels of every rig that have been identified with the traffic since its inception have added materially to their carrying capacity by being able to take a large percentage of their cargoes stowed on deck; and indeed but few dividends could have been earned had this not been possible.



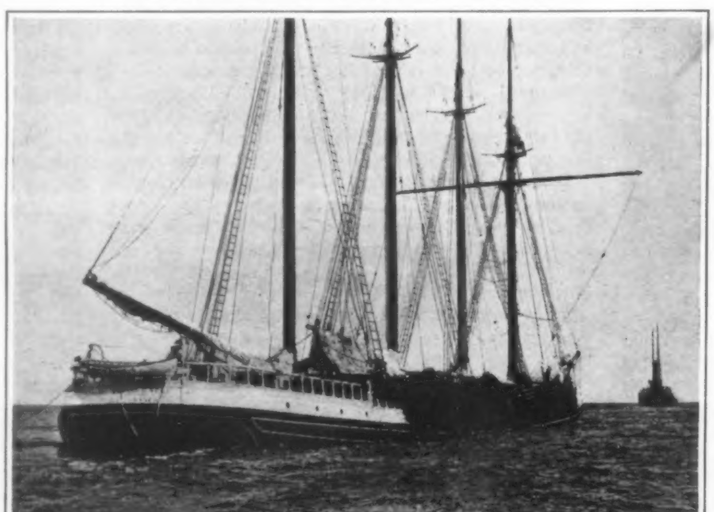
This vessel got into trouble because her water-ballast tanks were not fully filled.

German steamer "Wotan" as she returned to port.



During a storm the deckload of 1,400,000 feet of lumber shifted.

Norwegian steamer "Cuzco," listed 23 degrees.



A frequent mishap to schooners engaged in the lumber trade.

This four-masted schooner is waterlogged.

PERILS OF THE DECK-LOAD

Square-rigged craft, the pioneers of the trade, confined their deck-loads to spars and other large timbers. In vessels of the schooner build and rig deck-loads reached their maximum, fully three-fourths as much lumber being carried on deck as beneath it. The large steamships that have entered the trade of late years are following the example of the schooners, and leave port with deck-loads towering high above the rail.

A moderate, well-stowed and properly lashed deck-load does not constitute an element of risk. In fact, schooners are said to run steadier and handle better with a deck-load than without it. But when a vessel puts to sea with a deck-load that is excessive, badly stowed or improperly secured, she goes forth handicapped from the start and in poor condition to cope with the heavy weather.

Our navigation laws make it incumbent upon the owner or agent of any sea-going craft to indicate the draught at which he shall deem his vessel safe to be loaded for the trade in which she is engaged, the draught to be specified in the certificate of inspection; and they make it unlawful to load deeper than said line.

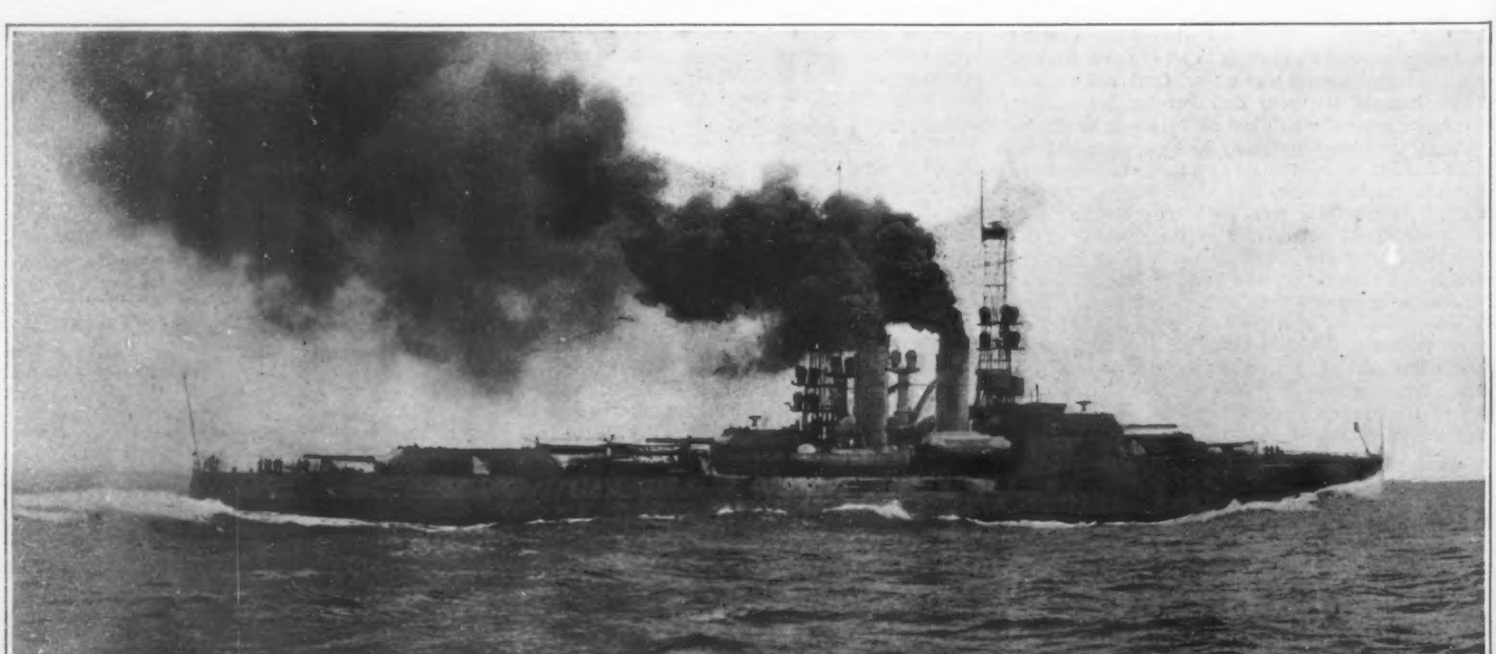
But this law is really a dead letter, for at least three reasons. First, it is left for the owner to set his own load line; and it is safe to assume that personal interest will enter largely into the question. Second, the load line is not plainly indicated as in the English merchant marine, where the Plimsol mark is painted conspicuously upon the vessel's hull, thus making over-loading instantly apparent. Third, there is no government inspection to ascertain whether a vessel is overloaded or not.

It is natural that those who charter vessels should endeavor to load them to their fullest capacity, and the only check to overloading is the inspector who looks over the cargo in the interests of the marine underwriters. That the inspector is not infallible is shown by the frequency of accidents at sea, many of which can be traced directly to over-loading. Take for example the case of the big British freighter "Argus."

This vessel, after taking on a large quantity of lumber at one of the Puget Sound saw mills, was proceeding to Bellingham to complete cargo. Her deck-load was one of the largest ever put aboard of a vessel reaching a height of 30 feet aft and 26 feet forward, above the deck.

While *en route*, without warning she went over on her beam ends to such a degree that the smokestack was almost on a level with the water. About 300,000 feet of lumber broke loose from the deck-load, en-

(*Concluded on page 316.*)



THE BATTLESHIP "FLORIDA" PLOWING THROUGH THE SEA AT A SPEED OF 22.54 KNOTS ON HER TRIAL TRIP OFF ROCKLAND, MAINE.

Photographic Distortion

Real and "Faked"

By C. H. Claudy

EVERY one who looks at the illustrated papers has observed that certain photographs are curiously distorted. Those who understand the cause, know that it is usually found only in pictures of objects which were moving rapidly when the picture was taken, such as railway trains, automobiles, jumpers, runners, galloping horses, etc.

Such photographs are almost invariably made with a camera in which the mechanism which admits the light which makes the picture is in the form of a roller-blind curtain, across the face of which is a slit. This slit travels from the top of the plate to the bottom. As the image on the plate, when formed by the lens, is upside down, the bottom of all such images is "taken" on the plate before the top. If the picture is that of an automobile, the bottom of the wheels is "taken" before the top of the wheels, the lower part of the automobile before the top of the driver's head, and so on. Now, if the automobile is moving quickly enough, the image of the automobile will move on the plate during the time it takes the slit in the curtain to cross the plate from top to bottom. The result is, of course, that each successive portion of the image is "taken" on the plate a little in advance of the portion immediately before, and the whole image seems to lean forward. A striking example of this is seen in Fig. 1, in which an automobile going ninety miles an hour was "snapped" very close to the camera. It should be understood that the closer the camera is to the object taken, the larger is the image, and consequently the greater the speed of the image across the plate. In this picture, it is obvious that the driver's head moved about five feet in the interval which elapsed between the "taking" of the bottom of the wheels and the time his head was "taken" on the plate. The whole automobile apparently leans forward.

Fig. 1.—A case of genuine distortion.

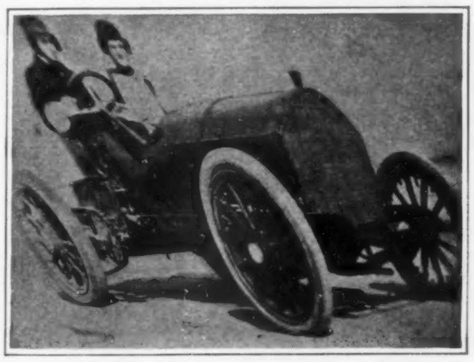


Fig. 2.—A case of trick distortion which was published as genuine.

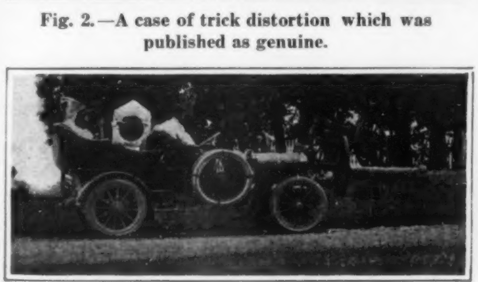


Fig. 3.—A normal print. Compare this with Figs. 4 and 5.

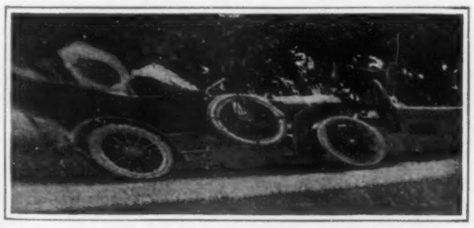


Fig. 4.—A fraudulent "high-speed ahead" picture.

The general public has come to recognize such distortion as meaning "speed," so that editors of illustrated papers have come to demand such pictures from their photographers to show speed. One press photographer who snapped pictures of races in which the cars were not distorted—so that they looked as if taken standing still—was told by his editor that he must get distortion! So he widened the slit in his shutter a little and slightly slowed up its speed, with quite satisfactory results to the editor.

Sometimes the little knowledge which is so dangerous makes an editor publish strange things, as in the case of Fig. 2, once published in good faith as the picture of an automobile, supposed to be going at a terrible speed. But it leans the wrong way! It is obviously a fake to those who know the subject. The sharpest part of the picture of the automobile is the top of the wheel, which goes faster than any other part; the blurred part of the photograph is the bottom of the wheel, which is least speedy when the automobile is going. And the machine, leaning the wrong way, must have been "speeding" backwards, or faked.

Figs. 3, 4 and 5 show how this effect was accomplished. Fig. 3 shows an automobile standing still, its occupants looking at the scenery. The negative from which this was made was put in an enlarging lantern and its image cast on a piece of sensitive paper just as the image of a lantern slide is cast on a screen. Then the paper on which the image was to be imprinted, was made to lean, so that the right hand edge was further from the lens than the left hand edge, the top further from the lens than the bottom. This produced the result seen in Fig. 4. Another print was made from the negative, this time with the left hand edge further from the lens, the top nearer the lens than the bottom, with the result shown in Fig. 5, in which a similar effect to that shown in Fig. 2 is obtained.

Of course not all speed photographs show speed distortion, but, when made with a focal plane or curtain shutter, the distortion is always there in high-speed pictures though it may be so minute as not to show. In horses and men, the distortion shows less than in mechanism because of the irregularity of the outline of the subject.

But horses and men, running or jumping, often *seem* distorted when, as a matter of fact, they are not at all, the "seeming" being caused by the catching of the jumper or runner in an attitude which, never *maintained* in life, is not familiar to the observer. Running horses have been painted for years with fore legs extended forward and hind legs extended backward, as a matter of fact, it is rarely that the camera catches any such attitude. Notice Fig. 6 and Fig. 7, as examples of high-speed photography of moving horses, in the first of which the horse at the left, going at high speed, has one foot on the ground and the horse to the right, two. In the second horse picture, the animal is going at a full gallop, but has two feet on the ground, and were it not for the strained position of the rider picking up the handkerchief, might be thought to be merely stretching his legs! These are *apparent* and not *real* distortions, since the wheels of the sulkies in Fig. 6 do not appear to have any real focal plane distortion whatever.

Fig. 5.—Trick distortion. The machine is speeding backward.

Fig. 6.—Apparent distortion. The wheels show that it is not real.

Fig. 7.—A curious attitude snapped by the camera.

The Brahmaputra Expedition

LAST November we published a brief article on that most interesting of geographic riddles—the Tsangpo-Brahmaputra question. Attention was called to the singular fact that despite years of effort on the part of explorers, no white man had yet set eyes upon the spot where the Tsangpo of Tibet becomes the Brahmaputra, and that the identity of the two streams had not yet been established by direct observation. In a second note on this subject we announced that the British authorities had determined to send a military expedition against the savage Abors, whose persistent hostility has hitherto kept explorers from reaching the long-sought goal.

Further information now at hand shows that the British realize the great scientific interest attaching to the invasion of the Abor country, and have taken measures accordingly. A number of scientific men are to accompany the expedition, including I. H. Burkill, who will make botanical collections; S. Kamps and R. Hodgist, who will carry out zoological and anthropological studies; and a geologist, whose name has not been announced. The topographical work will be directed by Capt. Trenchard and Lieut. Oakes. In fact, although nominally a punitive expedition, occasioned by the recent murder of two British officials, the undertaking has developed a scientific character that places it in somewhat the same category with Napoleon's famous Egyptian campaign; while on the geographic side it is hardly less noteworthy than the Younghusband Mission to Lhasa in 1904.

We may, therefore, hope soon to see in the illustrated weeklies and the scientific journals the first pictures of the wild and probably highly picturesque region where the great Tibetan River descends from a lofty table-land on its way to the plains of Assam. It is believed that the river falls 10,000 feet in a distance of 130 miles through a succession of gorges, rapids, and cataracts.

Night Storm Signals in Germany

FOR two years the German government has been experimenting with various forms of night storm signals, with a view to finding something acceptable to all countries, and suitable for international adoption. The triangular arrangement of lanterns formerly favored by the Germans has been abandoned, and the following code is in use provisionally at German sea ports:

Storm from the....	NW.	SW.	NE.	SE
Vertical arrangement of lanterns....	red red	white white	red white	white red

This agrees with the code recommended to the International Meteorological Committee by the U. S. Weather Bureau two years ago, except that the hurricane signal (red white red) is omitted. As the Germans were the principal opponents of this code, the outlook is now encouraging for the adoption of a simple and uniform set of storm signals in all countries.

Improving on Darwin

Johannsen's Theories of Evolution

By Benjamin C. Gruenberg

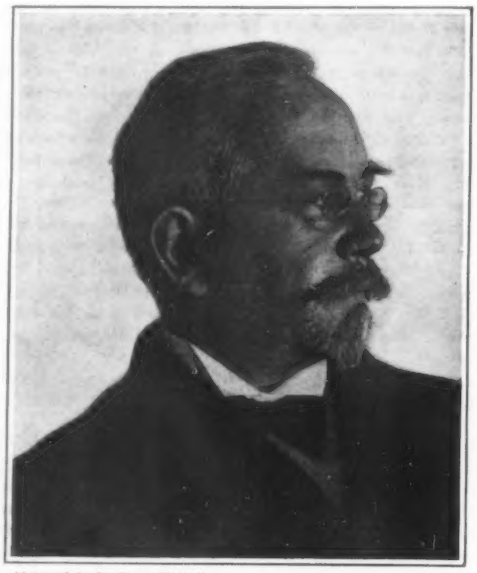
MOST persons who class themselves as "evolutionists" accept as a fact Darwin's principle of natural selection. During the past score of years, and especially during the past dozen or fifteen years, there have been brought forward the results of thorough-going experimentation and analysis which not only throw much doubt upon the "adequacy" of Darwinism to account for the evolution of plant and animal forms, but even question the efficacy of selection to direct the process at all, at least in the sense accepted by the older biologists. The work of Bateson, DeVries and others showed that variation is not *continuous;* that is, the differences between the individuals of any generation, or the differences between two succeeding generations, are not in all cases finely graded differences of degree, but the differences may be abrupt. The mutation theory of DeVries, based upon observations and experiments extending over twenty years, lays emphasis upon the fact that new forms arise suddenly, without exhibiting any graded connections with ancestral forms, in respect to certain characters.

Prof. Wilhelm Johannsen of the University of Copenhagen is another worker who has made large and important experimental contributions to the solution of the problems of evolution. In some ways he goes beyond DeVries and Bateson, and others of the radical thinkers in this field of thought. One reason Johannsen's work is not so well known is the fact that his analysis has been very subtle, and his writings purely technical. His large work in German, "Die Elemente der exakten Erblichkeitslehre," was published two years ago, and has not yet been translated into English.

The significant ideas developed by Johannsen may perhaps be best presented in relation to the older views. According to the Darwinists, the factors in organic evolution are variation, the struggle for existence, heredity and selection. By variation is meant the fact that the individuals of a species are not all alike, they vary among themselves; this is a matter of common observation. The "struggle for existence" is the application of the Malthusian idea to the world of plants and animals; each species tends to reproduce in a geometrical ratio, but the means of subsistence are limited and do not permit every individual that is born to reach maturity—the vast majority must perish early in life. The principle of heredity is the fact that "like tends to beget like." Finally, natural selection means that the individuals that survive are the ones that are naturally better adapted to their surroundings, and therefore are not exterminated in the struggle for existence; the good points that enable them to survive are transmitted to the progeny, and in the course of time the minute advantages become accumulated until the advantageous character is established as an essential part of the makeup of the species. Modern thought has analyzed each of these assumptions and has found them to be insufficiently precise in the minds of the Darwinists, as well as in the mind of Darwin himself.

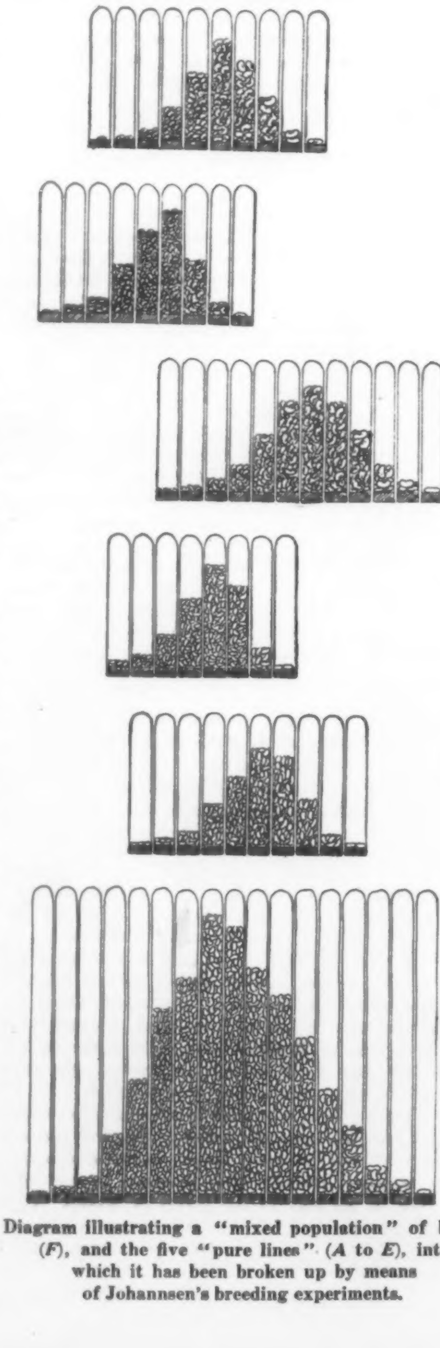
For example, "variation" was used to include all kinds of differences, those that separate true races as well as those that depend upon differences in nutrition or in function. These two types of variation are fundamentally distinct, and the modern school lays great stress upon this distinction: the former groups of variations are inherited, the latter are not. Johannsen points out that in assorting a large number of individuals of a species with respect to a given character, the variation within the group may show a distribution corresponding to the "law of probability" (diagram *F*) regardless of whether the group or population is homogeneous. Thus, in a human population made up of several distinct strains the distribution with respect to stature might be of the same mathematical form as that in any one of the strains. In such a population one of the exceptionally short individuals might be short because of under-nutrition during his growing period, or he might be short because he is a member of one of the short races. The only way to tell whether these quantitative differences between members of a group are due to heredity or to environment is by studying the pedigree or the breeding properties of the whole population, and excluding the effects of environment by having the outward conditions as nearly uniform as possible.

Johannsen accordingly made "pure line" cultures of self-fertilizing plants for several generations. Thousands of beans of a given variety were measured, and assorted according to length, or according to weight. There were very few of the smallest, and very few of the largest; the most numerous were those of medium size and the number of each larger size, or of each smaller size, decreased to the extreme. This distribution is illustrated in diagram *F*. Beans of known size were selected for growing, and the crop of each plant produced was kept by itself. The progeny of the largest beans were on the whole larger than the average of the original group; and the progeny of the smallest seeds were on the whole smaller than the original average. But if the selection was continued, a new fact appeared, namely, all the progeny of a single bean showed the same average size in each successive generation, whether large seeds were used or small ones. In other words, selection does not continuously shift the character of the group in any one direction. By continuing the pure line cultures, Johannsen separated out from his original group of beans five distinct types or races. (Diagrams *A* to *E*.) In each of these races or pure lines, the characters were pretty well limited; in growing crops from seeds, it does not matter whether the large seeds are selected or small seeds, the characteristic sizes of the next generation will be the same, under uniform conditions. It is true that a large seed will develop into a larger plant, and may produce a larger crop, but the average size of the seeds produced will not be any larger. On the other hand, if a seed is taken from the original mixed population, it is impossible to tell whether it is an extremely large seed of type B, for example, or one of the smaller beans of type C.



Photograph by Dr. George H. Shull.

Prof. Wilhelm Johannsen.



A

B

C

D

E

F

Diagram illustrating a "mixed population" of beans (*F*), and the five "pure lines" (*A* to *E*), into which it has been broken up by means of Johannsen's breeding experiments.

In order to distinguish these different kinds of variation Johannsen has introduced a new set of terms. Those who are afraid of new words may not see the need for these; but the justification lies in the fact there is no set of words that describe precisely the new ideas that have been developed, without implying too much. To express the idea that individuals are different, and without prejudging the nature of the differences, or their causes, we have the new word "phenotype." Individuals presenting different characters or different appearances—different phenomena—are different types; individuals that look alike are of the same phenotype. But since there are individuals of similar appearance and yet of different hereditary properties, as well as individuals of similar hereditary qualities but of different appearance, there is needed another word. The term "genotype" expresses the fundamental identity or potentiality of hereditary properties. For example, two albino mice may look quite alike in every way, yet transmit different pigmentation factors; these would be of one phenotype, but of distinct genotypes. On the other hand, a drone, a worker and a queen bee from the same hive would be different phenotypes, but of the same genotype.

An illustration taken from physics may be helpful. Ice, snow, steam and water are different phenomena, different appearances; each corresponds to a distinct phenotype—to all appearances they are as different as glass, sand, oxygen and alcohol. Yet we know that at bottom they are all forms of a compound which the chemist symbolizes "H_2O." H_2O is then the genotype, the fundamental entity that reacts now as water, now as ice, etc. On the other hand, we may see a row of bottles containing a clear, colorless fluid; they all look alike to us. If we cannot learn any more about them, if they do not produce distinct reactions upon us or upon the objects of the environment, we place them all in the same phenotype, although they may in reality be entirely different substances, from a chemical point of view. In the same way a dozen beans that look alike, have the same colorings, dimensions, etc., produce the same immediate reactions, are of one phenotype. They may be of the same genotype, or of two or three, or a dozen; this we can know only when we find out the potentialities of each in producing offspring, in transmitting characters, etc.

The experiments upon which these ideas are based are the so-called "pure-line" breeding. Francis Galton had found that there was a tendency of the offspring in certain populations to resemble the average more than did the parents; upon these facts he founded his famous "law of regression." Now Galton and others expected that by continuous selection from one extreme of a group, a new type could be established exhibiting the selected character in a higher average degree than the original population. But Johannsen has shown that the regression toward mediocrity occurs only if individuals are taken from a population made up of several genotypes. Within any genotype, established by breeding a self-fertilizing organism for several generations in a pure line, each group of offspring shows the same average character. Of course, pure lines are not easily cultivated except in self fertilizing species; but Johannsen has extended his generalizations to all

(*Concluded on page 317.*)

Curiosities of Science and Invention

The Pagoda on the Balanced Rock

ONE of the curious sights in Burmah is a huge boulder on Kelasa Heights that rests in delicate poise on the very brink of a rounded cliff. So unstable is the equilibrium that the rock trembles in the wind. Very naturally this odd freak has attracted the attention of the superstitious natives, who look upon it as a miraculous work of the gods. They believe that the rock is held in place by a hair of Buddha. Hence they have clambered to the top of the rock and built there a pagoda which is some twenty-five feet in height. Should the boulder ever fall (as is quite likely to happen) and dash to death a handful of worshipers, the blind faith of the devout people would not be shaken; for in the catastrophe, no doubt, they would see but a manifestation of divine wrath at some unconscious sin of commission or omission.

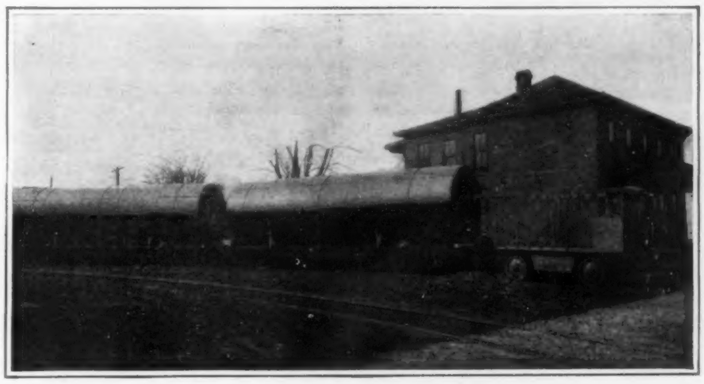
Balanced by a hair of Buddha.


Eleven feet six inches of beard.

Truck for Switching Cars

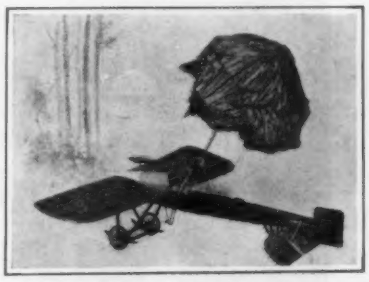
A VERY novel use of the electric storage battery truck is to be found at a factory in Fort Wayne, Indiana. The factory is located in a thickly populated part of the city, about six blocks off the railroad. It used to be necessary to haul matter to and from the yards with horse-drawn trucks. For this purpose eight wagons and three teams were employed.

A short time ago a franchise was granted for a spur from the railroad yards to the factory. One of the stipulations in the franchise was that no engines were to be used in transporting cars. In order to solve this problem a three-ton electric truck was purchased and fitted with special flanges to fit the tracks. It served the purpose excellently, and since that time a second one has been placed in operation. These trucks have a normal speed of from six to seven miles an hour and each will pull from one to three loaded cars. In the winter time, on account of the conditions of the track, one loaded car is all they attempt to haul. They can make on an average of four round trips an hour to the yards and a careful comparison shows that a conservative estimate of the amount saved is about $30 per day. The batteries in these trucks are charged at night so that practically no time is lost in this operation and a truck has never yet consumed the entire power in doing a day's work. In addition to doing all the switching these trucks find sufficient time to do considerable hauling from the city. With the exception of one small delivery truck which is used for light hauling and express purposes, the heavy electric trucks do all the hauling to and from the freight houses and elsewhere about the city. The freight houses are on an average of about a mile and a quarter from the factory.


Using an electric truck for switching cars.


Raised clear of the plunging machine.


Packed in the car body.


Unfolding and lifting the pilot's seat.

A PARACHUTE FOR AVIATORS

Cleansing Elephants of Durbar Paint

IN a land where somber colors are abhorred and the people clothe themselves in bright gaudy colors, where even the birds and animals are decked in the gayest of hues, one is surprised to find a beast with such a dirty gray skin as that of the elephant taking a very prominent part in official ceremonials. No matter how majestic the elephant may be because of his huge bulk and the solemnity of his gait, he cannot by any means be considered an object of beauty. No matter how gaily he may be decked with rich trappings the coarse mud-colored hide is decidedly incongruous. But the natives have made up for this shortcoming by painting the skin in most elaborate fashion. At the recent durbar in honor of the Emperor of India the elephants in the procession were thus clothed in gaudy paint. The accompanying illustration, taken from our English contemporary, the *Sphere*, shows the work of scrubbing off the gold paint after the ceremonies were over.

Scrubbing off the paint after the durbar.

An Eleven-foot Beard

NORTH DAKOTA holds the world's championship in the matter of beards as one of its citizens can boast of no less than eleven feet and six inches of beautiful wavy whisker. Mr. Hans N. Langseth, a native of Norway, is the possessor of this remarkable growth, which has been cultivated with care and pride for thirty-six years and has been increasing in length at the rate of almost four inches per annum. Mr. Langseth claims that instead of being a hindrance, this facial adornment is of real value, making an excellent chest protector in cold weather and warding off the chill blasts of the Dakota winters.

What Is a Man?

A Chemical View.—An average man of 150 pounds contains the constituents found in 1,200 eggs. There is enough gas in him to fill a gasometer of 3,649 cubic feet. He contains enough iron to make four ten-penny nails. His fat would make 75 candles and a good-sized cake of soap. His phosphate content would make 8,064 boxes of matches. There is enough hydrogen in him in combination to fill a balloon and carry him above the clouds. The remaining constituents of a man would yield, if utilized, six teaspoonfuls of salt, a bowl of sugar, and ten gallons of water.

A Physiological and Anatomical View.—A man has 500 muscles, one billion cells, 200 different bones, 4 gallons of blood, several hundred feet of arteries and veins, over twenty-five feet of intestines and millions of pores. His heart weighs from 8 to 12 ounces, its capacity is from 4 to 6 ounces in each ventricle, and its size is 5 by 3½ by 2½ inches. It is a hollow, muscular organ and pumps 22½ pounds of blood every minute. In 24 hours it pumps 16 tons. It beats about 72 times a minute. In one year an average man's heart pumps 11,680,000 pounds of blood. The heart is a willing slave, but sometimes strikes—and it always wins.—*Pract. Druggist.*

Parachute for Aviators

INVENTORS have been seeking for a good method of operating a parachute in connection with an aeroplane, so that in case the aeroplane should fall to the ground the parachute will remain in the air and come down gradually to the ground with the pilot. An automatic device of this kind, the invention of M. Max Bordes, was exhibited at the recent Paris aeroplane show. The different views which are given here will almost explain the working of the device in themselves, as it will be seen that the parachute is attached to the pilot's seat so that this latter serves as the car of the parachute when it descends. Usually the parachute is stowed in compact shape inside the aeroplane body and back of the seat. Means are provided for unbolting the seat from the aeroplane and at the same time releasing the parachute rod from the car so that it spreads out in the air when the aeroplane falls. The simple movement of a lever carries out all the needed operations so that the aeroplane will fall down, leaving the parachute in the air with the pilot. Around the seat is pivoted a fork which in turn holds the parachute rod, so that fork and rod carrying the parachute can swing either in the vertical or horizontal position. The fork is large enough not to interfere with the pilot's movement, and in the usual flight the rod and parachute are laid back and held in place by a lock device. The pilot's seat is held to the aeroplane body by bolts at each side which work upon levers so that he can unbolt the seat by working a hand lever, and this movement also releases the catch device of the parachute, detaching both seat and parachute from the aeroplane.

What Inventors Are Doing

Simple Patent Law; Patent Office News; Inventions New and Interesting

A New Rotary Engine

By L. J. Lesh

IN and about Buffalo, New York, a number of rotary engines are now in commercial use which, according to various reports, have proved very efficient. In order to verify these reports the writer recently visited the shops where these machines are built, and also looked up some of the en-

The inventor and his 5-horse-power rotary engine.

gines that had been in service from one to four years. Five different sizes of steam engines were in stock, ranging in power from 5 horse-power to 200 horse-power at 1,350 and 400 revolutions per minute, respectively, using 100 pounds of steam pressure with a safe 50 per cent overload beyond their rating. These engines were all of the simple expansion type giving two impulses per revolution. The inventor of this rotary engine, Mr. Benjamin F. Augustine, has also developed a compound rotary engine and has recently adapted his engine to internal combustion, using compressed gas by means which are not at present available for publication because of pending patents. As yet no university tests have been made of the efficiency and economy attainable in various powers, but preparations are now under way for such tests. Shop experiments show a maximum steam consumption of 38 pounds per horse-power hour for the 20 horse-power engine. It is unsafe to estimate the efficiency of large low-speed rotary units from that of small high-speed engines. In large reciprocating and turbine installations the steam is used to better advantage by compounding, which is impracticable in rotary engines.

The engines are equipped with automatic cut-off governors which maintain a constant speed from the condition of no-load up to full-load. Several of the weaknesses of the rotary engine as heretofore designed have been dealt with in an original way. Radial pressure against the rotor has been disposed of by using compensating sleeves. One of the weakest points of rotary engines is the seal between the inlet and the exhaust sides of the cylinders. This also has received special attention in Mr. Augustine's engine, as will presently be explained.

Referring to the accompanying drawings, the expansive fluid is introduced through an automatic cut-off balanced valve 1. The abutment or cylinder of the engine is indicated at 2, while 3 is the rotor eccentrically mounted in the cylinder bore. The rotor is formed with flanges, 6 at each end, which fit over the ends of the abutment and are held against play by the spring-pressed buttons 9. The rotor, together with its flanges, is slotted at diametrically opposite sides to receive the piston blades 4. As shown to better advantage in the cross-sectional view, the steam entering through the valve 1 passes up through the inlet 7, indicate by dotted lines, into the space between the abutment 2 and the rotor 3 and bears against the blade 4, causing the rotor to revolve. A steady expansion of the steam takes place until after the opposite blade 4 moves well past the steam inlet, when the rotary motion is continued by pressure, against the second blade. The steam exhausts through port 8. The blades 4 are formed with lugs that pass through the steam chamber into a pair of collars 12, mounted eccentrically to the rotor, but concentrically with the bore of the cylinder. Hence as the rotor revolves the blades are carried about by it, moving in or out relatively to the rotor, but pressing uniformly against the cylinder wall. The blades thus pursue a truly circular path although they must oscillate slightly in order to maintain their radial relation to the center of the rotor, rather than to their own center. Where the blades pass through the flanges 6, roller bearings are provided in the larger engines to prevent frictional losses. To balance the pressure of the rotor toward the exhaust side a sleeve or cap 5 is provided which is keyed to the engine shaft and thus virtually forms part of the rotor. This sleeve bears upon the outer wall of the cylinder which is formed with oil pockets all communicating through ports 10 with the interior of the cylinder. Thus the steam pressure is transferred through the abutment and bears against the sleeve 5, counter-balancing the rotor. The novelty

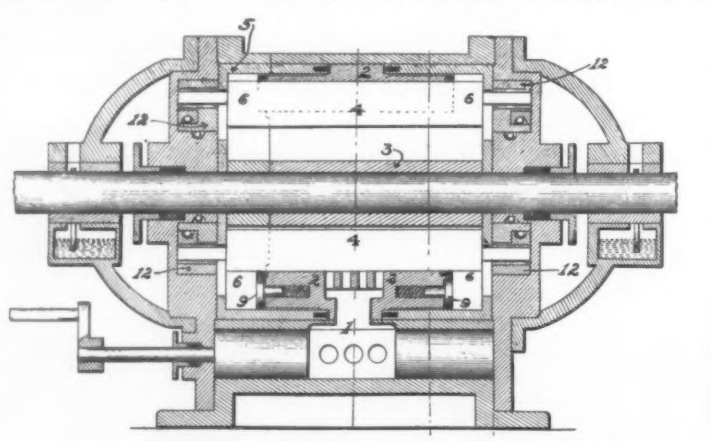


Fig. 1.—Longitudinal section of the center of the rotary engine.

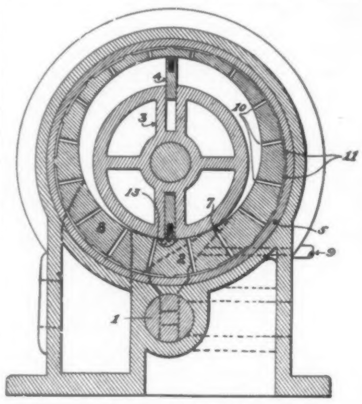
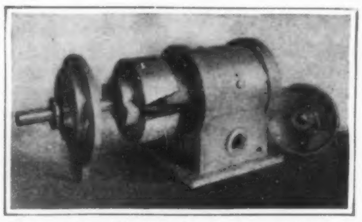


Fig. 2.—Cross section through the rotor.



The engine dissected and sleeve broken away to show a piston blade and the rotor.

of this device consists in placing the sleeve on the exterior of the cylinder rather than on the interior, as this permits constant lubrication of the joint between the sleeve and the cylinder. The oil is held centrifugally in place and remains there as a seal so that there is no loss of steam even to the extent of filling the ports and the pockets. There is absolutely no lateral thrust on the engine shaft. The rotor is so well balanced that it will continue to revolve freely even with the shaft bearings removed. At the point where the body of the rotor bears against the abutment there is a very slight depression concentric with the rotor. Here three little priming pockets 13 are formed. These are fed with oil and seal the joint between the inlet and exhaust sides of the motor as well as lubricating the rotor and the sleeve.

Edward Weston

Physicist and Electrical Engineer

TO-DAY the name of Weston is a household word among electricians. His fame has not been earned in a day; he has a long record of successes behind him.

Edward Weston was born at Brynn Castle, England, on May 9th, 1850. He early showed a marked inclination and propensity for mechanics; his parents however insisted that he should study medicine, and, unwilling to be thus forced into a calling not his own choice, the young man in 1870 left England and came to America. After spending a short period in the photographic laboratories of a firm of manufacturing chemists, he entered the employ of the American Nickel Plating Company, for whom he worked out a number of important improvements. In fact, it is not too much to say that to him is due in large part the credit for the fundamental processes of the vast nickel-plating industry of the world to-day. Having surmounted the chief difficulties incident to the electrodeposition of the metal, he next turned his attention to the current source, for which until then primary batteries had been used. His experiments resulted in the con-

struction of the first successful electroplating dynamo machine in 1872. This embodied for the first time the principle of field regulation, which is now in very general use. The first electric dynamo was invented by a Norwegian named Soren Hyjorth, and patented in Great Britain in 1856. Similar machines were subsequently built both in Europe and America, but little improvement was made until Weston undertook the study of the various factors affecting dynamo efficiency. It was he who introduced the very important laminated form for the core, which increased the commercial efficiency of the dynamo from less than 40 per cent to over 90 per cent. This is only one of the numerous improvements in dynamo design which the world owes to Weston. Incidentally it is interesting to note that the first application of the electric current for power-transmission for industrial purposes was made in Weston's factory, and there also the electric arc light was for the first time used for general illumination. A fact not very generally known, is that Weston is also the originator of the metal-impregnated carbon which in its modern form furnishes one variety of the "flaming arc." Of particular importance was his work in the development of the incandescent electric lamp. After some preliminary experiments with the platinum metals, he turned to carbon as the material best adapted for the filament of the lamp. Edison was at this time making the filament from natural wood fiber. Weston squirted a filament from plastic carbonaceous material, thus originating the method which is in general use to-day. To the field of commercial photometry Weston made a contribution by insisting on the statement of the luminosity of cources in terms of their "mean spherical candle power." It had been customary until that time to merely state the candle-power of the maximum ray, a procedure which is obviously calculated to deceive the public. The well-known resistance alloy manganin, whose value lies in the fact that its temperature coefficient is nearly zero, is also a product of Weston's researches. His studies of the Clark standard cell resulted in the "Weston" cell, in which cadmium is used in place of the zinc of the Clark cell, and which has been adopted on the universal standard of E. M. F. by the International Electrical Commission of 1908.

The various standard Weston instruments, the voltmeter, ammeter and duplex instrument, are too well-known to require description. The factory at which they are made is located at Waverly Park, Newark, N. J., and both the works and the laboratories are admirably equipped. Very special attention has been paid to the welfare of the employees, for whom there are provided club rooms, dining hall, library, gymnasium, swimming pool and other conveniences. The number of employees exceeds eight hundred. The total invested capital of the plant and its European branches is three million dollars.

If Edward Weston stands in the front rank as a member of his profession, he is no less remarkable in his personal qualities as a man. Those who have had the good fortune of a close acquaintance with him, bear the warmest testimony to his sterling worth. We have here another example of a fact for which we, as a community, have every reason to be grateful, namely, that marked intellectual powers are frequently associated with the highest moral character.

A Vacuum Cleaning Glove.—Walter B. Guild of Roxbury, Mass., has patented, No. 1,012,634, a vacuum cleaning implement which includes a glove to fit the hand of the wearer. This glove has in the palm portion between the forefinger and thumb and between the first and second fingers channels in which brushes are placed and an outlet adapted to be connected with a suction hose has ducts which communicate with the channels in the glove so that suction will be created in the channels to remove dust and the brushes may be utilized to loosen up the dust and increase the effectiveness of the device.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Electrical Devices.

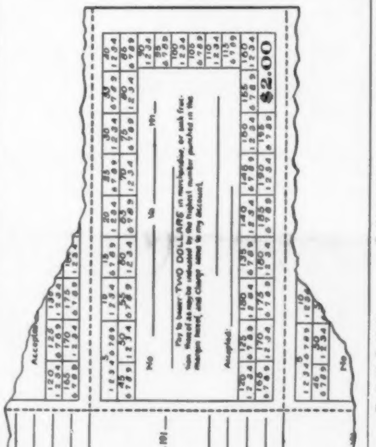
FIELDLESS MOTOR.—F. L. SOUTH, Baldhill, Pa. This inventor seeks to produce an electric motor, somewhat in the nature of a scientific toy, and used for demonstrating certain facts relative to the natural magnetism of the earth, and containing a revoluble armature which is in practice turned by merely sending a current through it, the magnetism of the earth co-acting with this armature and taking part in the cause of its rotation.

Of Interest to Farmers.

GRAIN HARVESTER.—C. F. JAHNS, Box 53, Route 2, Randolph, Wis. This harvester cuts the grain and binds it while in an upright position. To accomplish this, use is made of a cutting mechanism for cutting the grain, carrying means for carrying the cut grain rearward and then sidewise, and while held in an upright position, an upright binder finally binding the grain while in an upright position.

Of General Interest.

MONETARY DOCUMENT.—GILBERT N. KNIGHT, of Big Stone Gap, Virginia, has invented a form of scrip for the use of companies running a commissary, upon which is printed a series of numbers along the margin, denoting the amount of the purchase, and the punching and canceling of certain of these numbers serves to indicate the value of the purchase. As shown in the illustration, the scrip is arranged like bank checks in a check book, with blanks for the number, date and names of the payee and payer, and it is perforated along the margin, so that it may be removed with facility from the stub and from



MONETARY DOCUMENT.

adjacent checks on the sheet. The numbers along the margin are made in multiples of 5, printed in large type, while the intermediate numbers in smaller type indicate the amounts between these multiples. Thus, if the purchase be made for $1.58, the number 8 under the multiple 1.55 will be punched, which cancels all the numbers up to and including the one punched. If the purchase is made for an even multiple, say $1.55, the number 1.55 would be cancelled. The illustration shows a check for $2, or a fraction thereof. Of course the checks could be printed for lower or higher denominations as desired.

BRACING DEVICE FOR SUIT CASES.—L. SPIRO, Clarksburg, West Va. This invention is an improvement over a similar device disclosed in a former patent granted to Mr. Spiro. The present invention provides an improvement in which the brace is not hinged, but may be slipped into and out of a latch plate which is provided with openings to receive lugs on the brace proper. This arrangement provides an efficient bracing device, but it also permits removal of the brace entirely from the suit case.

PACKING JOINT.—H. T. CRONK, Manhattan, New York, N. Y. An object here is to provide a packing member, which will make a practically fluid-tight seal between the refuse tank inlet and the outlet therefor, which is constructed of collapsible material, so as to prevent the passage of gases and material except through the proper inlet and outlet. A further object is to provide a packing member which will be of a plurality of sections adapted to automatically come in contact with one another and close.

CEMENT MOLD.—H. W. CLARK, care of H. W. CLARK & Co., Mattoon, Ill. The invention is an improvement in cement-molds of the collapsible type, such as are employed in constructing pipes, sewers, drains, columns, and the like. In this case the invention is an improvement in the wedge type of fastening for the inner one of the two concentric molds usually employed.

Hardware and Tools.

EARTH AUGER.—R. T. JENNEY, care of Western Steel & Iron Works, De Pere, Wis. In the present patent the invention has reference to earth augers, and the improvement has for one of its objects the provision of an auger which may be manufactured at very little expense, and which may be readily adjusted for use in boring holes of different and of predetermined diameters.

Heating and Lighting.

SAFETY GAS BURNER.—N. WISE, Manhattan, New York, N. Y. This invention relates to safety gas burners, and the purpose of the invention is the production of a device of this class which will operate automatically to shut off the gas in case the flame should become extinguished accidentally for any reason. The general purpose is to prevent the occurrence of cases of asphyxiation or other accidents.

Household Utilities.

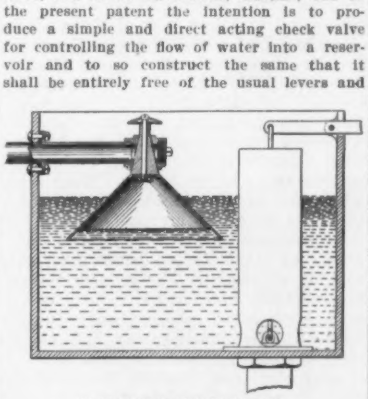
FOLDING WINDOW BLIND.—G. W. WEARN, 308 East Wade Street, Charlotte, N. C. One object here is to provide a device which may be attached to any window without making any change from the construction of the standard window frame. Another is to provide a device which may be applied to the inside of a window and which, when folded, is in a position out of sight behind the window curtain, when the latter is at its accustomed height.

CURTAIN FIXTURE.—J. KRODER, 107 E. 17th Street, Manhattan, New York, N. Y. For the purposes of this invention each bracket is provided with a socket having an interior annular bead, and the end of the rod is yielding and provided with an exterior annular groove, so that when the angular end is passed into the socket it yields in passing the annular bead, and the latter finally snaps into the groove, thus securely locking the rod in position on the bracket.

WINDOW SHADE ROLLER FITTING.—A. KAISERMAN, 105 West Avenue, Kankakee, Ill. This inventor provides means for a roller operable by gravity when it is disposed in both the horizontal and vertical positions, provides in fittings means for removing the locking devices therefrom without dismemberment of the fittings and the roller.

Machines and Mechanical Devices.

AUTOMATIC INLET VALVE.—S. C. CORNETT, and A. D. DAVENPORT, Gustine, Cal. In the present patent the intention is to produce a simple and direct acting check valve for controlling the flow of water into a reservoir and to so construct the same that it shall be entirely free of the usual levers and



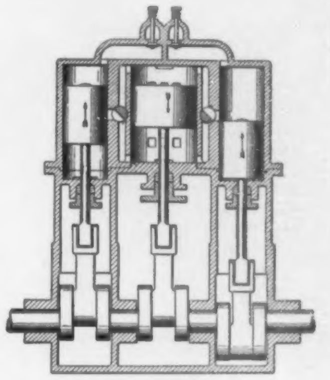
AUTOMATIC INLET VALVE.

connections between such levers and the operating parts of the valve, and to provide a valve so constructed that the upward movement of the float shall directly and without the intervention of other instrumentalities, close the valve and shut off the flow of water to the reservoir. The engraving shows a sectional view of a reservoir such as is used for flushing tanks and showing a vertical section of the improved inlet valve.

Prime Movers and Their Accessories.

REVERSING GEARING.—A. L. HERMAN, Bandon, Ore. This invention relates to gearing for general use, and more particularly to gears suitable for use with internal combustion engines. It comprehends a revoluble shaft and a countershaft to be driven by the same in either direction, according to the direction of rotation of the first-mentioned revoluble shaft, the countershaft, however, remaining idle for a moment whenever the first mentioned shaft is reversed in its direction of rotation and only taking up the rotation after the first-mentioned revoluble shaft has turned half a revolution.

INTERNAL COMBUSTION ENGINE.—S. PEARSON, Kerrville, Tex. This invention provides means for compounding the expansion effect to obtain the highest efficiency; provides for automatically operating the exhaust valve from the low pressure cylinder; provides a plurality of high pressure cylinders united for delivery to a single low pressure cylinder to deliver the partially expanded gases on opposite sides of the low pressure piston; pro-



INTERNAL COMBUSTION ENGINE.

vides for manually and at will reversing the operation of the pistons and the crank shaft connected therewith; and provides a plurality of high pressure 2-cycle engine cylinders operatively connected to exhaust into a low pressure cylinder, and to opposite sides of the piston therein. The illustration represents a vertical longitudinal section of a reversible 3-cylinder 2-cycle type of Mr. Pearson's engine.

Pertaining to Vehicles.

AUTOMOBILE HORN.—R. E. LONG, 51 W. 63rd Street, Bronx, New York, N. Y. This invention provides a hand operated mechanism for vibrating the diaphragm of a mechanically operated horn, said mechanism being arranged to affect a continuous sound; provides a picker device for the picker tooth of a diaphragm adapted to wear said tooth evenly and extend the area thereof; and provides means for varying the tone and intensity of the sound produced by the horn; and to reduce the wear on the pickers.

TIRE INFLATION INDICATOR.—A. J. DE LOTBINIÈRE, care of F. COCKBURN, Bank of Montreal, Head Office, Montreal, Canada. In this patent the invention relates to tire inflation indicators, and the aim is to provide one having a piston disposed against the inner tube of the tire, and adapted to be pressed outwardly by the pressure of the air in the inner tube, and against the pressure of the spring, an indicator being provided which is operable by the piston.

WHEEL TIRE.—H. L. BIENER, care of EUGENE GOTTLEIB, 140 Nassau Street, New York, N. Y. This tire is made in independent sections, removably attached to the wheel rim, and each consisting of a rim plate, a tread plate, a spring interposed between the rim plate and the tread at the middle thereof, and flexible inelastic connections between the ends of the tread plate and the rim plate.

HOLD-ON SAFETY TAP.—H. OTTE, 122 South Second Street, Terra Haute, Ind. This tap is for use in taking the place of screw-threaded nuts and holding in a safe manner two parts together, or for holding a wheel on its axle. An object of the invention is to provide a device which is simple in construction, inexpensive to manufacture, strong, durable, safe and positive in its action, and easily adjusted.

Designs.

DESIGN FOR CARPET OR RUG.—W. E. SAYERS, Thompsonville, Conn. In this elaborately ornamented rug there are several bands to the border composed of scroll, geometrical and flower designs. The body of the rug or carpet is figured with large scroll and flower formations.

DESIGN FOR A STATUETTE.—C. E. SCHULTZE, Manhattan, New York, N. Y. This ornamental design of a statuette comprises a plain chair standing upon a flat base, and across the entire back of the article is drawn in large letters the prayer, "Now I lay me down to sleep." A boy is kneeling at the chair in prayer, and opposite a pet dog leans against the chair. Mr. Schultze has designed another ornamental piece, comprising the same chair as the above with the same prayer and figure of the boy in the same position, but with the dog left out.

DESIGN FOR A BOX.—E. F. CALDWELL, Larchmont, N. Y. This exquisitely ornamental design embraces a plan view of the top of the box; a side view of the box; and an end view of the box. The top of the box is bordered with scroll designs, and the center comprises an elaborate collection of shields, heads, human figures, leaves, curled lines, etc. The side and the end display are designed in the same highly original and beautifully effective manner.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Readers' Service.

Hardly a week passes but the Editor receives letters from readers of the SCIENTIFIC AMERICAN *who ask him whether they shall send their boys to a technical school. Whether a boy shall become an engineer, a chemist, or a naval architect are questions that puzzle parents. The Editor will be pleased to aid readers of the* SCIENTIFIC AMERICAN *in deciding the matter of technical education for their sons. Address* EDUCATIONAL BUREAU.

II.—Shall My Boy Become an Engineer?

By Franklin DeR. Furman, M.E., Professor of Mechanism and Machine Design at Stevens Institute of Technology

[This is the second of a series of articles intended to set forth fairly the business possibilities of the technical professions. The articles are prepared by men who are connected with the more important technological institutions of this country and who are for the most part prominent educators. Because these teachers have instructed hundreds of young men in the principles of engineering, they are best qualified to write upon a subject so immensely important in the future development of American manufacturing industries.—EDITOR.]

FORTY years ago there were no technically educated graduates in mechanical and electrical engineering in the United States. Forty years ago there were no triple or quadruple expansion steam engines, no commercial oil or gas engines, no steam turbines, no dynamos—the compound steam engine was the highest developed form of motive power, and the world had been waiting thousands of years for that. Forty years ago the Atlantic cable was not yet prepared for continuous service, and there were no telephones, no phonographs, no electric lamps, no trolley cars, no automobiles, no aeroplanes, no wireless telegraphy.

Such light as there was to guide the profession of mechanical engineering from the earliest times up to the time of Watt's double acting expansion engine in 1782, was as the light of the stars at night; from Watt's time to the eighteen seventies, it was as the dawn; but in the seventies the daylight had come. Permanent and trustworthy service by cable commenced in 1872; the reversible action of the dynamo and its use as a motor was discovered in 1873; the triple expansion engine was introduced in 1874; the gas engine was patented in 1876; the telephone was patented in 1876; and the electric lamp became a commercial success in 1879. The first technical graduate in mechanical engineering received his degree in 1873[1] and the American Society of Mechanical Engineers was organized in 1880.[2] The progress of the past forty years in mechanical and electrical engineering has been simply marvelous. The reason cannot fairly comprehend the vast and powerful aggregate intellectual forces that have been at work during these four decades.

The writer has no mind to claim any undue credit for the wondrous unfolding of engineering advancement after 1872 for the technically educated engineer, for he knows full well that most of the startling inventions and many of the striking discoveries have been and ever will be made largely by self-developed minds combining unusual strength and daring. Such minds have been few indeed, and where one has succeeded many have failed, the lives of such workers leading either to brilliant success or to bitter failure. Even those who have had the greatest success have generally given at first only the simple demonstration that their inventions would work, or that their discoveries were roughly successful. The refinements and the reliability necessary to general usefulness came later, perhaps with the inventor's own developments but always with the co-operation of others.

Who else then, besides the great inventors, are responsible for the great burst of advancement in the last forty years? Who did the great work of perfecting and refining the myriads of little things that had to be perfected and refined before the great inventions became serviceable? The plain thoughtful mechanics of the '70s and '80s and '90s did a very, very large share, but would it be right to say that their art would have accelerated at any notably greater rate after 1872 than it had before, unless strong aid had been lent to it by the thoughtful and scientific work that began to be accomplished at that date by the newly created schools of mechanical and electrical engineering which started at that time?

The number of students in those days being small, and the application of science to shop and manufacturing methods relatively small, the early professors devoted their time largely to investigations and publications of their work. These writings were open to all, and many mechanics did better work because they were able to produce better material, and to machine it better because of better tools suggested very often by these writings of the professors. Soon the students of these technical colleges began to go forth and to carry personally into the shop, the drafting room, and the manufacturing office, new ideas—ideas involving methodical and scientific application to everyday actions. These were eagerly sought by the enterprising layman, although generally without outward evidence of appreciation by the shop workmen, if we are to judge by the stories these early graduates tell us of their reception in the business world.

Nevertheless the new ideas and methods of the technically trained engineer, the better material and tools which his study of science enabled him to develop, and the opportunity these new developments offered to the untrained engineers and mechanics, started in motion a nationwide and powerful advancement in mechanical and electrical engineering out of all proportion to any rate of advance that had preceded it.

But in the early days, as in the present day, although not to so great an extent by any means, the young, technically trained engineer, minus the practical training, did not get along very well with his brother, the practical engineer and mechanic, who was minus the theoretical training. They mixed about the same as oil and water, and there being so little oil and so much water, the oil did not have a good chance to show how well it could lubricate the wheels of progress. But to-day the field is dividing; it is large enough to have a recognized system for the oil, and one for the water, and both have learned to appreciate and respect the value of the other and the dependence of one on the other.

Where the position and particular usefulness of the technical trained engineer is not understood or appreciated, there is still friction, which leads to criticism of the technical graduate, criticism that is undoubtedly meant to be honest, but which is founded on a lack of understanding of the essential and underlying conditions of the great world progress in mechanical and electrical engineering during the past forty years. And where this criticism has been loudest and strongest and most widely circulated, it has been ineffective in detracting from the great work in the engineering colleges simply because those to whom the criticisms were directed, understood far better than the author of the criticism what the technical graduate stood for and the part he was taking in this great world progress. Furthermore, the public generally believed what the technical college catalogue statistics show, namely, that over 95 per cent of the graduates are successful in life in that they have a good livelihood doing a responsible work and enjoying educated, cultivated, and refined surroundings, and of these many live in affluence and are prominent in their home communities. The man who secures a diploma from any of the large engineering schools is assured of an opportunity of attaining a substantial position in life and no limit is placed on his ambition.

The Need of Engineers in Manufacturing

With such facts as these (which are known by the present writer to be true because of his personal knowledge and labor in compiling the records of *every graduate* of the first college of mechanical engineering in the United States) the manufacturers and engineers in this country are familiar in a general way, and they have not taken seriously the loud and sometimes vicious criticisms of those who have struggled hardest to stop the great wave of scientific and practical advancement. The most notable of all of the critics of technical education who made his wonderful progress and financial success without technical graduates at his

[1] Mr. J. Augustus Henderson, M.E., now living at Philadelphia, Pa., received this degree from Stevens Institute of Technology.

[2] The American Society of Mechanical Engineers was organized at Stevens' Institute of Technology, April 7th, 1880, and the first president of the Society, Dr. R. H. Thurston, was then professor of mechanical engineering at Stevens. Since the present year marks the end of the 40-year period referred to in this article, it is of peculiar interest to note that the president of Stevens' Institute of Technology, Dr. Alexander C. Humphreys, is now also the president of the American Society of Mechanical Engineers which has a total membership of nearly 5,000 men practically engaged in the profession of mechanical engineering throughout the United States.

elbow as he claimed, failed to see that his own success was due very largely to the development of better material for him to use, better tools for him to use, and better methods for him to use, which he and his working force, great as it was, never could have developed alone. The benefits of the applications of science to engineering and manufacturing, which have had their often small and unnoticed origins in the technical colleges, and which have had their practical and ultimate development often at the hands of the practical mechanic, have flowed in to benefit the man who criticised as much as to benefit the man who believes and co-operates in the great progress of the time. This progress has been so great and so vast and is so evident to all, that it can afford to extend its benefits to all.

Much is left yet to be done by the mechanical engineer. The land, the sea, and the air have been conquered, and the world has probably seen in these past forty years more diverse and remarkable inventions and discoveries than will ever again be seen in any future forty-year period of the world's history. But it cannot be said that no other future period will not outstrip the present in progress of a most valuable kind, for in spite of our great achievements, the one great desideratum of civilization, namely, economy of life and processes, has scarcely been touched. There is a great field here for technically trained engineers and when this field of our industrial progress is cultivated many years hence, there will ever be the demand for the technically trained man to keep it in order.

The mechanical engineering profession is still in the very early morning of its life and it opens up to young men who have a liking for mathematics and mechanics and at the same time a cultivated and balanced mind, an assurance of a high and respected position in life.

The Titanothere—An Extinct Ancestor of the Rhinoceros

A NEW and noteworthy exhibit consisting of a series of life-size heads of the titanotheres, gigantic horned monsters, extinct distant relatives of the rhinoceroses, is just being installed in a special alcove in the Hall of Vertebrate Palæontology of the Museum of Natural History, New Work. In these effective restorations Prof. Henry Fairfield Osborn has publicly presented for the first time a very instructive and realistic picture, both of the life appearance and the wonderful evolution of these great mammals.

Under the direction of Prof. Osborn, Mr. William K. Gregory, and in conference with other members of the staff, Mr. Erwin S. Cristman have skilfully modeled the heads. The front page photograph shows the first ancestral type of the group, small and hornless, and the last final member at the pinnacle of their evolution, with massive head, three feet long, and enormously developed horns, two feet in length.

The titanotheres went through their known evolutionary history and reached their climax of great size and extreme horn development during the first half of the Age of Mammals. They were the dominating animals of their day, some approaching nearly the size of an elephant, others averaging eight feet high at the shoulder and fifteen feet in length. Herds of these mighty beasts roamed the ancient flooded Plains of Western America, especially in the region of the Dakotas, some two million years ago. They were heavy limbed, slow moving, possessing broad spreading feet, like those of the tapir or rhinoceros, having four toes on the fore foot, and three on the hind.

The powerful titanothere was not a true grazer, for in comparison with the "white" rhino, its grinders had low crowns and lacked the "cement" which is so characteristic of the teeth of grass-loving ungulates. Also its front teeth were feeble, their prehensile function being very possibly unsurped by a heavy upper lip. The first ancestral member of this family, entirely hornless, was about the size of the smallest Shetland pony, and is found in the Bridger Eocene of South Dakota. A small restoration of this diminutive creature is pictured under the large head. The species increased rapidly in size and length of horns. In the time period estimated to have been one million years, according to geological reckoning, the skulls gradually flattened,

till the latest member had developed two giant bony horns, several feet long, dominating the entire front of the skull. Most of the best preserved skulls and fossil remains of these animals have been discovered in the single geographic region, now the Big Bad Lands of the Dakotas, and in a continuous series of deposits, known as the "White River Group."

These titanotherium beds have left a wonderful panorama of the life-history of the animals and show that they went through their entire final evolution and extinction in a short period of two hundred feet of formation. Titanotheres, though the dominant and most formidable animals of their day, suddenly became extinct at the close of the Lower Oligocene Age. Their extinction is attributed principally to their defective grinding teeth not being adapted to the changed conditions of vegetation and climate. The increasing aridity and development of grassy uplands favored the evolution and existence of herbivorous plains—living, open country, types, light limbed and swift, with long crowned teeth and elongated feet. Herds of small fleet horses which existed in enormous numbers, together with other grazing animals in the regions of South Dakota and Nebraska, it is thought, may have cut off a large part of the food supply of the titanotheres, thereby aiding toward their final extinction. Prof. Osborn is preparing, with the assistance of Mr. W. K. Gregory, an elaborate and comprehensive monograph on the titanotheres from the rich and remarkable material obtained by various museum expeditions for the United States Geological Survey. This work will throw a new flood of light on and greatly extend all knowledge as to these little known animal inhabitants of the ancient Dakotas.

Perils of the Deck-load

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abling the vessel to partly right herself. Some of the lumber, however, got foul of the propeller and brought the steamship to a sudden stop. Only the prompt letting go of the anchors prevented the craft going ashore.

Arriving at Bellingham, an effort was made to replace the lost portion of the deck load, when the vessel again went over on her side, her smokestack and masts resting against the face of the dock. The crew scrambled ashore along the smokestack. After two such emphatic hints, her deck load was reduced somewhat and the vessel put to sea and arrived at her destination without further mishap.

Sometimes the improper stowage of cargo between decks, or failure to trim the ballast tanks, makes a deck load a menace that would under other circumstances be perfectly safe.

Some months ago the German steamship "Wotan" took on a heavy deck load consisting of large timbers and creosoted piling, and she was proceeding out of Puget Sound when she went over on her beam ends with a suddenness that threw her crew into a panic. She was brought into a sheltered bay under a slow bell, but did not right herself until a large percentage of the deck load was removed.

The underwriters' agent, who investigated the case, claimed that the accident was due to the fact that the water ballast tanks were but partly filled. Apparently this was a reasonable contention; for after the tanks had received proper attention the piling was replaced and the vessel put to sea on an even keel.

A few months later the Norwegian steamship "Cuzco" had even a more thrilling experience. She had left Puget Sound for Panama with a large cargo consisting in part of 2,800,000 feet of lumber, about half of which was in the form of a deck load that reached a height of 16 feet above the bulwarks.

The vessel had hardly cleared the coast when she ran into a storm of unusual violence. A huge wave struck her fairly broadside, and careening under the force of the blow, her deck load shifted, carrying the steamship over to an angle of 35 degrees. Here she lay, threatening to turn turtle any instant. The steering gear was so completely jammed that the craft was practically helpless.

Although the deck load projected fully six feet beyond the bulwarks, only one small lashing broke, liberating about 20,000 feet of lumber. Had it been possi-

ble, the lashings would have been let go and the deck load sacrificed to ease the ship. But this action was not possible, and for hours the huge carrier wallowed in the trough of the sea, taking in water rapidly through hatches and rivet holes. By good seamanship the vessel was turned about and brought slowly back to port, retaining a list of 23 degrees. The mainmast shrouds and stays had been carried away, the mast bent and the bulwarks torn out.

These accidents, and many more that might be enumerated, have had a tendency to awaken shipowners and underwriters to the perils of an excessive deck load, and the desirability of an improved method of securing deck cargoes. It is held by many, especially by the shipmasters who have to take the risks, that deck loads should bear a certain specified ratio to the between deck cargo, taking into consideration the construction and rig of the various vessels, and that there should be government inspection to prevent overloading.

In regard to deck lashings, it has been contended that some uniform system of fastenings should be brought into use, whereby in moments of grave peril the deck load could be released promptly and without danger. Heretofore there seems to have been a tendency to secure the deck load so thoroughly that it could not break away under any circumstance. Cables are run back and forth in an intricate maze and are so securely fastened with turn-buckles that it is impossible, no matter how great the need, to let go the deck load and relieve the vessel without great danger to those engaged in the effort.

A fastening is already in vogue consisting of a hook so secured by a link that a sharp blow with a maul will release it; but for some reason it has not come into popular use. The use of such a fastening, or an improved form, will probably result from the present agitation. Perhaps a fastening will be perfected that will act automatically when subjected to extraordinary strain, such as arises when a vessel is thrown over upon her beam ends.

Improving on Darwin'

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organisms, and he has restated the known facts of heredity in terms of "genotypes." As a result of his experiments he concluded that selection can never establish genotypical differences, and that therefore, "natural selection" could never have given rise to new species. His conclusions are in perfect harmony with the results obtained by DeVries, as well as with the results of the many experimenters on "Mendelism."

Johannsen's ideas help to explain the observations of breeders that certain characters can neither be made to blend by crossing, nor can they be increased nor reduced in any way.

The expression "unit characters" has been used by many writers for the idea of the simple characters of which a plant or animal is made up; for example, the color, hairiness or baldness, dimensions, early or late ripening, etc., have been considered units, and breeders have expected these qualities to appear as wholes in the plants or animals with which they were working. Johannsen does not speak of unit characters; he expects most characters to be the expression of the mutual reaction of two or more factors. In this he is in accord with such experimenters as Castle, Punnett, Correns and others. The factors are the units that are concerned in heredity. This view readily explains such facts, for example, as "reversions to type" or "atavism" as result of crossing. If we assume the ancestral trait in question to be the realized reaction of two or more inherited factors, we can see how it has failed to show itself in two or more strains for many generations: each strain had one or several of the factors, but not *all*. On crossing two distinct strains all the factors necessary for producing the "wild" type are brought together in one individual and the result is a reversion to the ancestral type. This kind of reversion has been produced at will over and over again by many experimenters, with pigeons, rabbits, mice, poultry, etc., as well as with many plants.

In rejecting the idea of purpose in creation, the ingenuity of scientists has been

put to great strain to explain the facts of adaptation. In most plants and animals common observation shows so many fine adjustments, apparently, between the organism and its surroundings, that the idea of purpose suggests itself even to the young child. The Darwinian hypothesis seems to explain adaptation without postulating purpose; but if selection is *not* operative, how are the adaptations to be explained? Apart from the fact that many organisms exhibit structures or instincts that are not at all useful, or that are even harmful, Johannsen points out that many characters that are commonly considered adaptations are not adaptations at all, in the Darwinian sense. For example, hairiness in plants is often useful as a protection against grazing animals; but many plants have hairs although they grow in situations that never expose them to the danger of being attacked by grazing animals, nor are the hairs of any other discoverable value to the plants. Moreover, hairs or spines have been made to develop in a new generation of plants, whose ancestors had no hairs, by producing certain changes in the temperature or the water conditions; here the appearance of hairs is simply a physiological response to certain special stimuli. In still other cases a cross between two hairless plants produces hairiness, that is, the hairiness is here a genetic reaction, the result of combining certain hereditary factors. In these cases there is no question whatever of use or adaptation, or "fitness." There is, therefore, no reason for assuming that this character must be accounted for in terms of use or "purpose" when it is found to occur in nature in situations where it does apparently confer some advantage.

In a swamp we often find plants that show special adaptations to the peculiar situation, and the common proceeding has been to "explain" the characters in terms of the demands made by the situation; but in the same environment may be found species of plants which show none of the special "swamp characters," but which nevertheless thrive as well as "swamp plants," and just as well as they do on the heath, or on the hillside. The same may be said of many color characters. The whiteness of the polar bear is more likely to be a physiological or genetic response to the extreme cold than an adaptive or selective response to the whiteness of the surroundings. The color patterns of tropical butterflies have been described as adaptations for protection; they may be nothing but the physiological results of the food, or the activity, etc., of the species; or they may be the results of certain types of hybridization. (See an account of Punnett's experiments in this direction, SCIENTIFIC AMERICAN, January 28th, 1911, under the title "Mimicry With the Mimic Left Out.")

It is true that if an organism is thrown into an unfavorable environment, or if its characters interfere with its physiological processes, the species will die out, but it is not necessary to assume that every peculiarity of structure or habit is the result of adaptation to the needs of the species. We may expect that in time each species will be crowded into the corner in which the conditions are most favorable to it, or where they are the least unfavorable; and in this way it may come to show a fitness or adaptation. But it is a mistake to suppose that the adaptive characters originated in response to the needs of the organism.

Here Johannsen makes the shrewd observation that Darwin, who repudiated Lamarck's doctrine of the inheritance of the results of use and disuse, and other acquired characters, himself falls into the Lamarckian fallacy. This he does by assuming that fluctuating variations are inherited. If the progeny of a single self-fertilizing plant are all grown under conditions as nearly identical as possible, we find that the largest seed and the smallest seed produce in the next generation seeds of the same average size; the difference between the largest and the smallest are due to the action of external conditions, and are therefore "acquired characters," and cannot be transmitted. The mistake Darwin and many of his followers made was the failure to analyze just exactly what the word "variation" meant every time it was used. It is to the clearing up of our understanding of this fact of *variation* that Johannsen has made his greatest contribution. The practical outcome of his experiments and

the development of his methods will also do much to advance agriculture and horticulture.

Growing Easter Lilies to Order

ONLY a few years have passed since the introduction into this country of the Easter lily. Prior to that time the flower was known as the Bermuda lily. It was a Philadelphia florist who first received, from some friends in Bermuda, a few samples of the snow white lily, whose beautiful blooms were a delight to his astonished eye. He put them forward as an Easter flower, and their popularity was instant. Churches in general which still looked at Palm Sunday decorations as part of a ritual to which they might not accede, found at Eastertide an outlet for the human craving for beauty which they were glad to welcome. The tall, white flower year by year has won its way from city to city, and now it is used universally as an Easter decoration.

Bermuda has reaped a harvest in lily bulbs, and even at the present day most of the lilies are brought from that little isle in the shape of bulbs, though thousands upon thousands of plants in bud and bloom are also brought in to this country for the season's trade. The larger cities such as New York, Chicago, Boston and Philadelphia each receive from 200,000 to 300,000 bulbs during the months of July and August. They are shipped from Bermuda packed in shore sand. Each bulb measures from seven to nine inches in circumference, and the average price for the embryo lilies is $85 a thousand. A florist in a large way of business will take from 10,000 to 15,000 bulbs and plant them at once. The temperature must then be kept where the root growth only will start, and it is not until the chill of October that they are taken to the green house, where a warmth no higher than 55 degrees is allowed them. Within a few weeks of Easter the plants are allowed to hasten their bloom, and if they appear to be at all backward, from 70 to 75 degrees of heat is given them in order that they shall blossom out in all their glory by the day the Lord made.

It requires a full month to bring an Easter lily to its zenith of glory, and it takes no more than three weeks to exhaust the pure splendor which has been the outgrowth of all these months of care and preparation.

The experts of the Department of Agriculture at Washington have been trying to discover a rival to the Bermuda lily. Various experiments have been carried on by these experts, chiefly for the purpose of securing new types of lilies by hybridizing and crossing and to demonstrate the practicability of growing lilies for Easter in the United States directly from seed. One of the most promising of the hybrids has resulted from crossing the Philippine lily and the Bermuda lily. The Philippine lily takes but two months to come into bloom from the period of planting the bulb, while the Bermuda and its various relations require five or six months. There would be a great saving of time could an Easter lily be grown in from one to two months. With a view to bringing this about the hybridization of the Philippine and the Bermuda lilies has been effected, the result being a flower larger than the familiar Easter lily, but not quite as broad and a little shorter than the Philippine flower.

Up to this time Americans have had to rely for a very sparse supply of Philippine lilies upon the Philippine Islands, and they arrive early in the spring when they cannot be used for forcing. By growing them in California they can be obtained in the fall in good time for forcing into flower during the winter. The plants so far grown in California do not show signs of the lily disease, which has menaced the producers of the Bermuda flower in this country. When these flowers come into bloom they are cross-fertilized with certain purposes in view. The seed from these plants are sent to California about the end of the summer, where they are planted out in the spring in fields, and in a year the growth made by the seedlings is so great that hundreds of plants have been recently produced bearing in the neighborhood of thirty flowers to the stem. Some of those produced last season from two and three-year-old plants were large and most satisfactory.

It would seem that this method of reproduction by seed is the true solution of the problem of the Easter lily industry in the United States, an industry amounting to millions of dollars each season.